SCIENTIFIC AMERICAN

SUPPLEMENT, No. 951

Copyright by Munn & Co., 1894.

Scientific American Supplement, Vol. XXXVII. No. 951
Scientific American, established 1845.

NEW YORK, MARCH 24, 1894.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

[From the Engineer, London.]

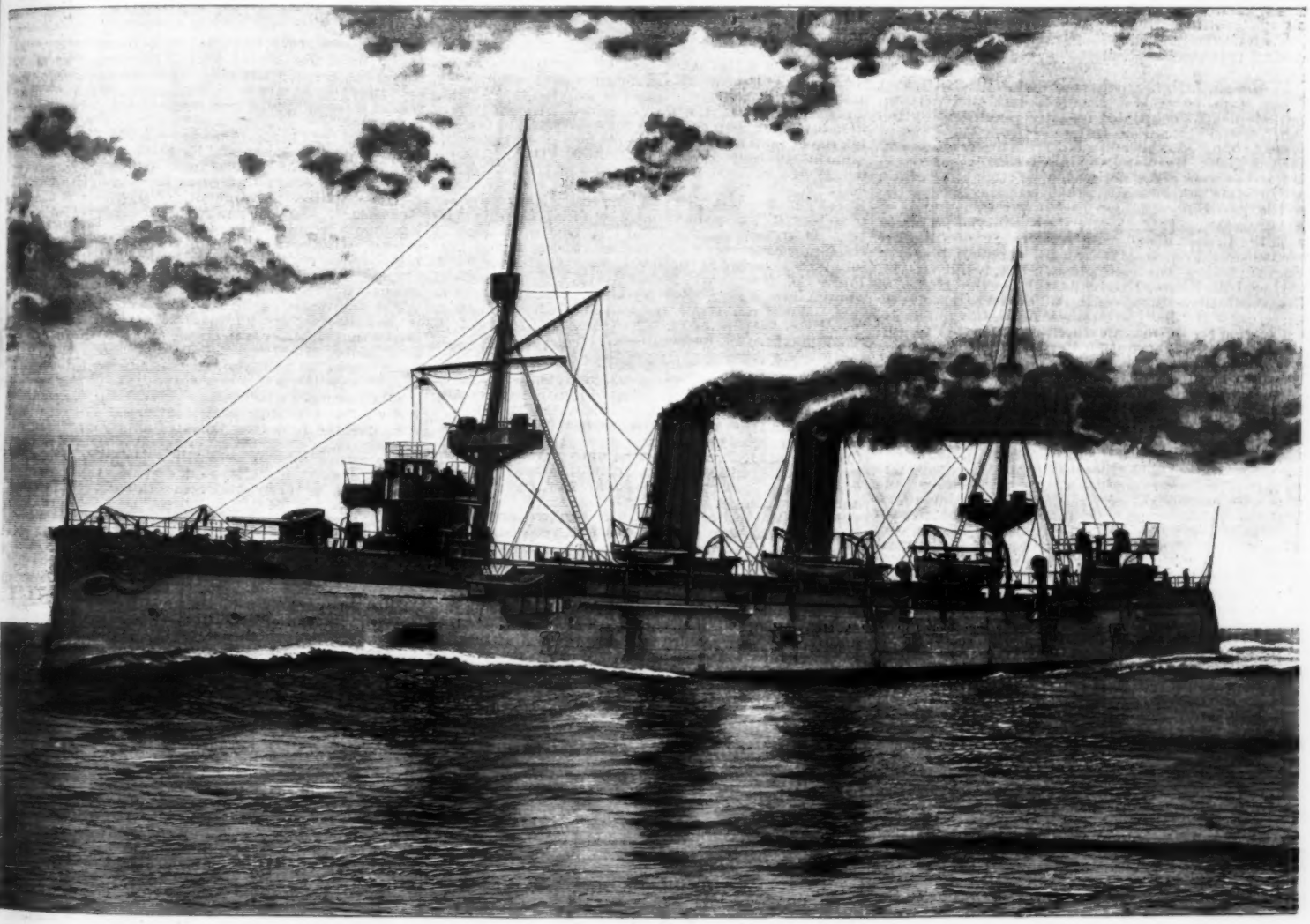
THE JAPANESE CRUISER YOSHINO.

Our engraving illustrates the Japanese protected cruiser Yoshino running at her top speed, twenty-three knots. Our engraving has been prepared from an instantaneous photograph, for which we are indebted to Messrs. Sir W. Armstrong, Mitchell & Co., of Elswick. She is the fastest sea-going vessel in the world—faster a good deal than anything in the United States navy. Within the last two weeks she has left this country for Japan, and the reports which have been received leave no room to doubt that she is an exceedingly good sea boat as well as a powerful war ship. It is to be regretted that she belongs to a foreign government instead of to the British navy.

The Yoshino is the same class of vessel as the 9 de Julio and 25 de Mayo, constructed by the same firm for the Argentine government, but exceeds either of them in size and speed, and is, moreover, provided with a double bottom, which they have not. The results of the speed trials carried out last July off the mouth of the Tyne far exceed any yet obtained from a sea-going vessel, and prove her to be the fastest cruiser now afloat, a fact having this significance, that there does not exist anything in the form of a ship that could escape from her if pursued. The Yoshino is 350 ft. long, 46½ ft. broad, and her displacement at load draught is about 4,000 tons.

During the natural draught trials the ship attained a mean speed of 21·6 knots, with forced draught 23·031 knots, or 26·51 miles per hour. At the turning trials it was shown that the ship could turn through 360 deg. in three minutes and eight seconds; the diameter of the circle measuring 375 yards. This was considered a remarkably small circle for a vessel of the length of the Yoshino. The helm could be put from hard-a-port to hard-a-starboard in thirteen seconds, and the engines could be reversed from full speed ahead to full speed astern in a few seconds. The vessel thus possesses in a very high degree the handiness and maneuvering power which are so essential to a cruiser of this class.

The armament of the vessel consists of four 6 in., eight 4·7 in., and twenty-two 3 pounder quick-firing guns, and five torpedo tubes. One 6 in. gun is placed on the forecastle and one on the poop, each gun being capable of firing through an arc of 270 deg., or all round the bows to 45 deg. abaft the beam on either side for the forward gun, and round the stern to the same angle before the beam on both sides for the after gun. The other two 6 in. guns are carried in sponsons at the level of the upper deck, one in each bow, and have a range of fire from 3 deg. across the bow to 60 deg. abaft the beam. The eight 4·7 in. quick-firing guns are carried in sponsons at the level of the upper deck, the aftermost pair being close to the poop, and firing from 3 deg. across the stern to 60 deg. before the beam, and the other six—three on each side—have each a range of 120 deg. The twenty-two 3 pounder quick-firing guns are disposed as follows: Two at the after end of the forecastle—one on each side—so as to get a training arc of about 80 deg. abaft the beam, and two similarly placed on the poop; four are placed in the military tops, two in each; eight on the upper deck bulwarks, and the remainder between decks, thus obtaining a complete command of every possible direction of approach to the ship. One of the torpedo tubes is in the stem for right-ahead fire, the other four are training tubes, and fire on the broadside, two being placed in a chamber forward on the main deck, immediately before the machinery compartments, and the other two in a similar chamber aft of those compartments. Her machinery—as was to be expected—coming from Messrs. Humphrys, Tennant & Co., worked most satisfactorily throughout the whole of the trials, and the Japanese government may be congratulated on the possession of one of the finest, swiftest, and most powerful war ships of her class afloat.



THE JAPANESE PROTECTED CRUISER YOSHINO.

A French paper publishes some interesting statistics as to the number of foreigners in France. It appears that there are 465,860 Belgians, 286,042 Italians, 83,000 Germans 11,900 Austrians, 14,357 Russians, 39,687 English, 12,000 Americans, and 80,000 Spanish and Portuguese.

THE ERA OF NICKEL-STEEL.*

By W. L. Austin, Ph.D.

Attention had long been directed to the unusual properties displayed by meteoric iron, both in regard to its extraordinary toughness as well in some instances to its non-corrodibility. Again and again during the present century investigators appear to have returned to this subject in examining the physical qualities of these celestial visitors and by endeavoring to produce artificially similar alloys. Meteoric iron is never pure, but is invariably associated with nickel and other elements and the desirable qualities attributed to it are ascribed to this fact. It became clear at an early date that iron alloyed with nickel differed materially from the pure metal, but certain obstacles were encountered in bringing these metals together, and even when this was effected the results were far from corroborating each other. Faraday experimented in this direction by melting horseshoe nails and pure nickel together in various proportions, reaching finally only contradictory results. Berthier also made some alloys of the two metals, producing a mixture corresponding to that of a meteoric iron found near Bogota. In 1861, Longmaid patented (British patent No. 1863, A. D. 1861) some alloys of iron and nickel, but used only very small amounts of the latter metal. Liebig examined the same subject in 1832. Mr. Fairbairn, in 1858, recorded the results of some experiments on alloys similar in composition to meteoric iron, and Boussingault as well investigated the subject in connection with researches on metallic meteorites, which, in fact, seem to have been the incentive that urged on all early investigators of these alloys.

But all efforts to manufacture a commercially valuable alloy of iron and nickel were in vain until a few years ago, the trouble being that the tremendous influence of minute quantities of other accompanying metals and metalloids was not understood nor suspected. It is strange that the effect of impurities on the

* Extracts from paper read before the Colorado Scientific Society, December 4, 1893.

alloy should have been unappreciated for so long a time.

Kunzel, in his report on the Vienna Exposition, speaking of the experiments made in 1860 at the Liege cannon foundry, in which it was aimed to improve the quality of ordnance metal by the addition of a little nickel, says the result was negative, and declares he cannot understand what qualities of the iron (roheisen) or nickel warranted the undertaking. Even Ledebur himself has predicted that the new nickel-steel alloys belong to that class of inventions which crop up at intervals, finally to be buried in oblivion because of their impracticability.

Probably the first appearance of nickel-iron alloys in the United States was when Philip Thurber, of Detroit, at the New York Exposition in 1853, exhibited some products of the iron furnace at Marquette, Mich. This iron was made from a nickeliferous limonite and possessed some remarkable qualities, but it was not until 1888, after experiments had been made first in France with crucible nickel steel alloys, and subsequently in England with similar mixtures produced in the open hearth, that the subject was brought to general notice.

In May, 1889, Mr. James Riley, at the request of the Iron and Steel Institute of Great Britain, read a paper at their meeting in Glasgow, in which he set forth the results of the experiments he had been making with nickel-steel. Riley had been over in France, at the invitation of Marbeau, for the purpose of looking into the claims made for certain crucible nickel-steels by that engineer, and having satisfied himself as to their genuineness he returned to his works in Scotland and began experimenting with similar material, using an open-hearth furnace in the place of the crucibles employed in France. The results obtained by Riley are given very fully in the proceedings of the Iron and Steel Institute. Notable among them was one nickel-steel alloy containing 4·7 per cent. nickel, which showed an elastic limit of 28 T. per square inch and a breaking strain of 40 T. per square inch, whereas similar steel, without the nickel, showed only 16 T. and 30 T. respectively. The elongation and contraction of area of this steel were, moreover, not materially impaired.

In August, 1890, the papers stated that the United States Naval Board was about to test "a newly invented nickel-steel plate" recently purchased by the Chief of the Bureau of Ordnance from the Creusot Works. On September 18 and 22 this plate was tested at Annapolis, Maryland, together with other representative armor plates submitted for trial, to ascertain which style of protective armor was the best for use on the new United States men-of-war then building. At these competitive armor trials the victory rested with the French nickel-plate steel, as against another carbon-steel French plate, and a compound one of English make. On September 26, 1890, a bill was introduced and immediately passed by the House of Representatives appropriating $1,000,000 to enable the Secretary of the Navy to purchase nickel ore and nickel mattes for armor manufacture. It appeared to outsiders as though the authorities were acting with undue haste in the matter, and immediately stories began to circulate detrimental to the new material, suggesting the possibility of a "job" lying at the bottom of the hasty action on the part of Congress. It was stated that the new steel became exceedingly brittle when subjected to great cold; that its magnetic properties were such that ships' compasses, under certain conditions, could become totally deranged; in fact, that the new product was very unreliable and uncertain in its behavior. It appeared as though experience with alloys of iron and nickel on the part of experts had been for too long a period of a doubtful nature to admit of an opposite opinion being hurriedly reached.

Mr. Tracy, however, who was at that time Secretary of the Navy, decided to have very careful tests made of this armor before adopting any kind in the new navy, and proposed to employ for such test plates that were to be made of American material by American mills. As a result of this decision, orders were given to the Bethlehem Iron Company and to Carnegie, of Pittsburg, to prepare such plates, the government furnishing the necessary nickel for the work.

Shortly afterward Mr. W. L. Abbott, of Carnegie, Phipps & Co., in reporting to Mr. Tracy the progress in the manufacture of nickel-steel plates at the Homestead Works, near Pittsburg, showed samples taken from some of the material out of which the trial plates were being manufactured, and which had been rolled down to three-fourths inch for experimental tests. These gave an ultimate tensile strength of 100,000 to 102,000 pounds per square inch, with an elastic limit of 59,000 to 60,000 pounds. The elongation was 15½ per cent., with reduction of area of 29½ and 36½ per cent. respectively at fracture.

The toughness of nickel-steel is very great. During a visit which the writer made to the Bethlehem Works last spring, a large field was observed which was covered with blocks of nickel-steel that had been cut off during the process of manufacturing the armor plates. Many of these ingots weighed several tons. They had been set out in the open field adjoining the works, because it was said that no profitable method of breaking them up into sizes suitable for returning to the furnaces had yet been devised. Attempts had been made to blast them with dynamite, but the explosive shot out of the holes as from a cannon, doing little execution on the blocks. Another illustration of the toughness of the metal is given in the late experiments by the German government, where shells were exploded in cannon—the one of ordinary gun steel, the other of nickel-steel. The former was badly damaged, whereas the latter was only enlarged.

One by one the objections raised against nickel-steel have been removed. The effect of cold weather on the plates was experimentally demonstrated to be of no importance, and in April, 1891, the first nickel-steel plates of American manufacture began to arrive at the Washington Navy Yard for testing purposes. Plates of all descriptions, with and without nickel, were exhaustively experimented with. High and low carbon steels were shot at; plates just as they were rolled or forged, and others which had been surface hardened (Harveyized), were again and again subjected to the fire of the most formidable modern ordnance made, rifles as high as 12 inch caliber being used. These tests extended all through the summer, fall and winter of 1891 and 1892, and are still in progress, a plate being taken for testing purposes from each lot of material delivered by the works. The results have demonstrated beyond all doubts the superiority of nickel-steel for armor purposes. The tough, tenacious material flows under the impact of the shot, and in the case of the Harveyized plates, the extreme hardness of the exterior surface, re-enforced by the tough, untreated steel behind, shatters the forged steel Holtzer projectiles, which have hitherto proved irresistible.

DAHL'S SULPHATE CELLULOSE PROCESS.*

EXPERIMENTAL trials have been made with almost every known alkaline fluid likely to be suitable, as regards cost, for removing the incrusting materials from plant fibers. Ammonia, caustic and carbonate of soda and sodium sulphide or the corresponding salts of potassium have all been tried, yielding in some cases very indifferent results. Ammonia solutions, for example, are too inactive and are quite unsuitable. For this and other considerations it cannot be successfully used as a solvent. Like solutions of caustic potash, it is very expensive, although the latter body acts perfectly. A comparison of the relative costs of soda, potash and ammonia will not be out of place, for by this the position of caustic soda and of other alkaline soda products in the manufacture of paper pulp will be more clearly understood.

At the present time the relative costs of ammonia, soda, and potash are about as follows:

Ammonia NH_3	£55 per ton.
Potash K_2O	50 "
Soda Na_2O	14 "

It is obvious from these figures that unless the quantity of potash and ammonia used for pulping is very much less than that of soda (which, in truth, is not the case), any process based upon the use of these reagents is not likely to live as a commercial manufacture.

The two alkaline soda products which have been universally adopted are caustic soda and sulphide of sodium. It is to the application of the latter that we wish to direct the attention of our paper-making readers. This reagent has been almost exclusively associated with the name of the late Mr. C. F. Dahl, an engineer of Danzig, who obtained a patent in 1884 in many European countries for a method of preparing paper pulp from fibrous plants by digesting them in aqueous solutions of sodium sulphide. During the recovery of the soda from the spent alkaline lyes, he added a proportion of sulphate of soda or salt cake to the calcining ash, which was converted into sulphide of sodium by the reduction action of the organic matter. The residuum was then dissolved in water, and the liquor causticized with the lime and again used for boiling. It appears, however, that the Manchester Paper Co., New York, boiled straw with sulphide of sodium liquors long before Dahl took out his patent in 1884. Wood and straw pulp are both made in large quantities by this process in Germany, Austria and Scandinavia at the present time.

THE PROCESS.

The chopped wood, straw, esparto, etc., is subjected to the action of a lye containing four different combinations of soda, viz., sulphate, carbonate, hydrate and sulphide, in large wrought iron boilers. The digesting process is carried out under pressure, and it is said that 100 parts of moderately dry pine wood require about twenty parts of the above mixture of salts in solution; while straw, esparto, and similar raw stock require only 10 or 12 parts.

Spruce and other pine woods require a pressure of from 5 to 10 atmospheres (75 to 150 lb. per square inch above the atmosphere), and the strength of specific gravity of the alkaline lye varies from 6° to 14° Baume. The time required to complete the digesting varies from 4 to 30 hours. On the other hand, esparto, straw, etc., are boiled at a pressure of 2 to 4 atmospheres in a solution of 5° to 8° Baume for 3 to 8 hours, as the nature of the plant may require. During the boiling process, the incrusting materials surrounding the fibers of the plant are dissolved, while the cellulose is left behind.

When the boiling is finished the brown lye is run off from the pulp digesters and evaporated, the residue being finally calcined, then withdrawn and dissolved in water and causticized. The cellulose remaining within the boiler is removed and placed in washing vats, where it is washed with warm water to get rid of the soda. It is then broken up into pulp in a breaking engine in the usual way and bleached with bleach liquor.

The color of the unbleached pulp is grayish yellow, but it may be bleached to a high degree of whiteness or left of a slightly yellowish tint, according to the amount of bleach liquor added.

PREPARATION OF THE LYE.

Dahl recommends that sulphate of soda be used for the preparation of the sodium sulphide liquor in the following manner: The salt cake is first dissolved in water, and then boiled with 20 or 30 per cent. of its weight of well burnt lime. The lye prepared in this way can be used for boiling the plants, but some of the soda residue recovered from the black lye is added to it to bring it up to the right composition.

The black lye is thickened to the consistency of tar by evaporation in an evaporating oven, strongly calcined, and after the gases evolved during the decomposition of the organic matter have ceased to come off and the mass is charred, the residue is withdrawn, dissolved in water, and the resulting solution used for preparing fresh lye.

For preparing the pure salt without mixing it with carbonaceous matter, the thickened lye is withdrawn from the furnace and burned by itself in a smelting furnace at a dull red heat. The melted mass assumes a brownish red color on cooling, is easily soluble in water and possesses nearly the following composition:

Sulphate of soda	16 per cent.
Carbonate of soda	50 "
Caustic soda	20 "
Sodium sulphide	10 "
Foreign substances	4 "
	100

* From *The Chemical Trade Journal.*

The composition of this recovered product varies a good deal in accordance with the nature of the fibrous materials which are being digested and with the care with which the furnacing has been carried out. These, however, do not interfere much with the solvent power of the liquor which is afterward made from it.

This recovered salt is now dissolved as soon as possible after it is withdrawn from the furnace, in order to avoid oxidation of the sulphide of sodium, which, as every chemist knows, is rapidly oxidized when exposed to the air. During the boiling and recovering processes from 10 to 15 per cent. of the salt is lost. Under normal conditions of work this loss is replaced by an equivalent quantity of sulphate of soda or salt cake. That is to say the correct lye for boiling by this process is made from a mixture of 85 per cent. to 90 per cent. of recovered salt of the above composition, 10 to 15 per cent. of sulphate of soda dissolved in water and boiled with 20 or 30 per cent. of burnt lime. According to Dahl, the proportions of recovered salt, salt cake, and lime used for preparing fresh lye depends upon the percentage recovered. Thus the following figures are the proportions given by him:

Percentage loss of Salt.	Recovered Salt.	Sulphate of Soda.	Burnt Lime.
10 per cent.	90 parts	10 parts	20 parts
15 "	85 "	15 "	23 "
20 "	80 "	20 "	25 "
25 "	75 "	25 "	28 "
30 "	70 "	30 "	32 "

It is not advisable to add more than 30 per cent. of sulphate of soda to the recovered salt, because the liquors will then be very inactive and fail to properly reduce the fibrous plant to pulp.

The proportions of salts contained in the liquor are on an average as follows:

Sulphate of soda	37 per cent.
Carbonate of soda	8 "
Caustic soda	24 "
Sulphide of sodium	28 "
Foreign salts (inactive)	3 "

Unless great care be exercised in the recovery, etc., of the soda, the composition of the liquor as above stated changes a good deal. The general aim of the manufacturer should be to obtain as large a decomposition of the sulphate of soda into sulphide of sodium as is possible.

It is said that the soda made by Leblanc's method is better than ammonia soda for Dahl's process, because it contains sulphide of sodium. Sulphate of soda or salt cake is also much cheaper than soda (Na_2O), and as the sulphide of sodium which it yields is already "caustic," if the term can be used in a perverted sense, less lime is required to prepare the liquors for the digesters. On the other hand, more ash or soda residue is recovered per ton of pulp made than in the ordinary soda pulp process, which means fractionally more expense in this department.

The knowledge of the reaction going on within the pulp boiler is very limited, but experience certainly shows that the fiber is stronger, and is consequently of more value. Dahl also claims to get a higher yield of pulp, about 10 per cent. increase, in fact, over the caustic soda method, when working his process.

In a German factory where this system was continuously worked for some years, seven parts of recovered soda residue and two parts of lime were used for causticizing. On 3,000 parts of good recovered residue, 700 to 800 parts of lime were used in Dahl's system, while in the soda process 1,200 to 1,300 parts of lime are required. A properly managed sulphate cellulose factory should not use more than 30 parts of burnt lime per 100 parts of pulp; and a soda cellulose factory not more than 50 parts of lime for the same weight of product.

ANTICHLORS.*

WHEN paper pulp is bleached with gaseous chlorine, or with solutions of hypochlorites, the bleaching agent is supposed to penetrate into the pores of the fibers, and to be removed with great difficulty in the ordinary process of washing. Hence there has arisen the necessity of destroying the remaining chlorine or hypochlorite by the aid of a chemical reagent. The reagents thus employed are called "antichlors." They attack the chlorine, transforming it and themselves into comparatively harmless bodies, which are either washed from the pulp before sizing or are left remaining in it, and for the most part pass away with the water from the machine.

From a chemical point of view all antichlors are reducing or deoxidizing agents, with but one exception, namely, ammonia. Those in common use are mainly formed by the union of sulphurous or other oxy-acid of sulphur with soda, and, in fact, comprise the following series of salts:

Hyposulphite of soda	$Na_2S_2O_3 + 9Aq.$
Sulphite of soda	$Na_2SO_3 + 6Aq.$
Bisulphite of soda	$NaHSO_3$

The two former of these are well defined crystalline salts, and are sold as such; but the last is a liquid and sold as a strong aqueous solution in casks.

As above stated, there is a fourth antichlor, namely, ammonia, which is used in the state of hydrate or as liquor ammonia, and is the only alkali that is found to be applicable in virtue of its well-known reaction with chlorine, thus: $4NH_3 + 3Cl = 3NH_4Cl + N$. The products of this reaction, gaseous nitrogen and sal-ammoniac, are perfectly harmless, both as regards their action on the pulp or on the machinery, and, therefore, ammonia is considered to be the best antichlor known. It possesses, however, a disagreeable, stifling smell, is rather offensive to use, is much more costly than any of the antichlors above enumerated, and hence its application is limited. According to Lunge and Schoch, it is necessary to add a somewhat large excess to the pulp and to allow it to remain in contact for a considerable time before it acts effectually, both of which conditions are against its general practical use. In the manufacture of copper plate papers, where the presence of the sulphur antichlors and the products of their decomposition are apt to act upon the engraved plate, ammonia is certainly the best and most suitable antichlor.

* From *The Chemical Trade Journal.*

Hyposulphite of soda, a crystalline salt extensively manufactured on the Tyne, by the oxidation of soda waste, is the most universally used antichlor. Its action is similar to that of sulphite and bisulphite of soda. The chlorine decomposes the water in the presence of this salt, forming hydrochloric acid, and liberating oxygen, which oxidizes the hyposulphurous acid to sulphuric acid, which in its turn forms acid sulphate of soda. Another reaction of greater importance to the paper maker can take place instead of the above, yielding bodies that must be considered more dangerous than acid sulphate of soda.

The hydrochloric acid can act upon the hyposulphite of soda and liberate free hyposulphurous acid, which, being an unstable body, splits up into free sulphur and sulphurous acid. The former of these two bodies remains in the pulp, and may give rise to disagreeable results. It is also liable to slow oxidation to sulphuric acid, which will locally destroy the fiber. It is generally recognized among paper makers that the excessive use of this antichlor tends to destroy the wire cloth of the paper machine, and there is no gainsaying this fact. Yet, hyposulphite of soda can be used without causing any damage. Care should be taken that the quantity employed is not greater than that necessary to kill the chlorine, allowing for a moderate excess, and that the pulp is washed after the chlorine has been practically destroyed. Where water is scarce, or the beating capacity of the mill is insufficient, it will undoubtedly be found that the wires will be rapidly destroyed by the free use of this antichlor. In such instances hyposulphite of soda should be used judiciously.

Both sulphite and bisulphite of soda are superior antichlors in many respects to the above one; neither of them acts so deleteriously upon the wire cloth nor upon the brass rolls of the machine. There are several kinds of those antichlors in the market, differing from one another with regard to the percentage of sulphurous acid they contain, or the amount of chlorine they will destroy. Many years ago one of the firms now embraced in the United Alkali Company, Limited, introduced to the paper trade a very pure sulphite of soda, containing a large percentage of sulphurous acid, which for cheapness and strength has not been equaled or surpassed. This product is a hydrated sulphite of soda of somewhat indefinite chemical composition, but may be said to be substantially the hydrated salt $Na_2SO_3 + 2H_2O$. Like the crystallized sulphite, which contains six equivalents of water, it is freely soluble in water, but should not be stored, nor dissolved, in wooden vessels, owing to its action on the wood. Where much antichlor is employed, and especially when acid has been used to accelerate the bleaching process, it is better to dissolve an equal weight of carbonate of soda with the sulphite. The alkali has the property of neutralizing any acids that are present in the pulp, and those that are formed during the subsequent treatment.

The finest papers are prepared from white cotton and linen rags, and require little bleach liquor to bleach them. The action of hypochlorite of lime (bleaching powder) is much less destructive upon the fiber than chlorine gas, and consequently the latter is seldom used for this class of work. This is also true of other fibers as well. The destructive action of gas bleaching is due to the formation of free hydrochloric acid, which "tenders" the fiber by transforming it into hydrocellulose.

There are some colors which are destroyed by the smallest trace of chlorine or hypochlorite, and it is imperative that the excess of bleach liquor associated with the pulp be either removed by washing or destroyed by the careful use of an antichlor. In cases of tub sizing it is especially advisable not to use an antichlor at all, but to wash the pulp with pure water till it is shown on testing to be free from chlorine by the iodide of potassium and starch test; or to add just enough bleach liquor to bring the color up to the desired degree of whiteness, so that no excess of hypochlorite will remain. The presence of chlorine in pulp for tub-sized papers is quite as bad as the presence of antichlors. It has been found by experience that the presence of either free chlorine or antichlors in papers which have been tub-sized causes the latter to undergo a change when kept for a time, and the judicious use of both is the best course that can be recommended.

SULPHITE DIGESTER LININGS.*

IN the early days of the sulphite wood pulp manufacture, the greatest difficulty to be overcome was found to be in the construction of boilers that would effectually withstand the corrosive action of the bisulphite liquor. In the year 1866, the inventor of the "sulphite process" employed a lead lining, and today this method of protecting the iron shell is still in use. It was found at that early period that the sheet lead crumbled and cracked after working for a short time, necessitating constant and extensive repairs, with corresponding stoppages. Wherever this method of lining is employed, the frequent stoppages for repairs still exist; and it is not surprising that practical men should endeavor to shun it and try to find a proper substitute, to insure more continuous working.

Much ingenuity has, therefore, been displayed in the several schemes proposed to overcome the difficulties of this question. Some of these proposals doubtless suggested themselves to Mr. Tilghman, the original inventor of the process, in the early days of his experiments, but were not followed up by him, because of the many fears as to the future, and the expense involved in the development of what was then a very difficult manufacture.

The reason why lead is apt to crumble and crack apparently lies in the fact that the ratio of the coefficient of expansion of this metal to that of iron is as 28: 12; and also in the peculiar property possessed by lead of refusing to contract to its original length when heated and cooled. That is to say, a strip elongates when repeatedly heated and cooled. To counteract this an alloy of antimony and lead was early suggested, which was found to yield properties superior to pure lead, inasmuch as first, the alloy was much harder, and second, the difference in expansibility between it and iron was not so great. The use of this alloy was nevertheless found to be faulty in many respects, and it has had to give way to another; and, also, to other linings which to-day constitute the most prominent detail in the construction of sulphite pulp digesters.

The alloy referred to is that of so-called "bronze," a mixture of copper and tin. Digesters made entirely of this material originated in America, and great expectations were based on some early results obtained with them. Good bronze, of uniform texture, if one may so speak, is, however, difficult to make, especially when the castings are large; and it was soon found that the bronze showed local wear and tear, causing parts of the digester to become weak. A deplorable accident which occurred in the United States with one of these boilers has made manufacturers regard them less favorably, and although several of them are still working in America, owing to the above and to their great original cost, their future application is not assured.

The most ingenious, and at the same time the most universally employed, lining with all its modifications was first suggested and developed by Mitscherlich in 1876. The object he had in view was to coat the interior of an iron digester with an acid-resisting substance which would not bulge or crack by heating, and which would be more durable than lead. After much patient experiment he constructed a digester, the outer shell of which was of steel plate protected inside from corrosive action by a lining of glazed bricks, tongued and grooved and set together with cement. As an additional protection, a thin sheet of lead was placed between the shell and the bricks (*C. T. J.*, 296, *p.* 42). The principle of this method is one which has been largely adopted in a series of modified applications, all more or less successful, but associated with names other than that of Mitscherlich.

Cement when "set" is fairly acid-resisting, and possesses nearly the same coefficient of expansion as iron. It therefore forms a very efficient lining; and many modified methods of employing this body as the basis of a lining have been introduced. Kellner and Partington in England, Wenzel in Austria, and a host of others too numerous to mention by name, in America, Germany, and Scandinavia, have their own peculiar methods of applying it.

Kellner and Partington's method, which is used in the well-known Barrow Pulp Works, consists in forming the lining of a mixture of cement and ground slate, thoroughly incorporated with a solution of silicate of soda in a mortar mill. This paste is applied to the cleansed boiler shell in a series of layers, the compositions of which differ from one another in regard to the quantity of silicate in the mixture; the layer nearest the shell containing proportionately the most. Small bricks or tiles are embedded in the paste, to add to its acid-resisting properties; and instead of ground slate, sand, ground glass, bricks, or hard burnt earthenware are substituted. There cannot be any possibility of doubt as to the success of this lining for sulphite pulp digesters.

Another system, closely resembling the above, has been working for many years on the Continent with equally signal success. It was introduced into an Austrian works by the late Wm. Wenzel, of Vienna, and employs porcelain tiles embedded in a mixture of cement and ground earthenware or fire bricks. The tiles are shaped to fit the curvature of the boiler, and form a smooth surface, which offers little resistance to the travel of the pulp within the boiler.

The formulæ for making the cement are not all alike, but the following is likely to answer well:

Ground earthenware... }	In equal proportions.
Ground firebricks ... }	
Sodium silicate solution 30° B.....	1 part to 2 of above mixture.

The Wenzel lining has now been working uninterruptedly in Continental pulp factories for some years, which in itself is a guarantee of its efficiency.

It will be unnecessary in this cursory review of the methods of lining sulphite digesters to dwell longer on those schemes in which earthenware bricks, tiles, and cement are the component parts, for the above examples are typical of many others so closely resembling them that it is difficult to discriminate their special features, which would enable one to isolate them as individual methods. There is, however, another lining which we have not mentioned, namely, that brought out by Salamon and Brugger about three years ago.

This consists of a thick coating of sulphate of lime deposited upon the inner surface of the boiler, and is said to effectually protect the iron. It is a matter of common knowledge that water while hot holds less sulphate of lime in solution than when cold. Advantage has been taken of this by these inventors for forming their deposit upon the boiler. The digester is filled with a cold saturated solution of sulphate of lime and heated, insoluble sulphate of lime of a very dense hard character is deposited, and as the water evaporates more solution is added till the deposit has increased to the desired thickness. Digesters protected by this coating are at work in the United States and in Germany, yielding, apparently, good results.

Enamels have also been suggested for lining pulp digesters, but they do not seem to have found as much favor as cements. The following, however, is an enamel which forms the subject of an American patent:

	Parts.
Lime	5
Fluorspar.....	10
Salt.....	5
White sand.....	50
Litharge	50
Boric acid.....	20

The whole is mixed and melted together, then ground and mixed with water to the consistency of paint, and applied hot to the digester plates. A second coat is then added composed of:

	Parts.
Calcined bones.....	10
Talc	5
Cryolite	4

There are many advantages to be gained by the use of these linings in preference to the older lead lining. Their original cost is undoubtedly greater, but they last much *longer*, cost less for repairs, allow the work to proceed with greater regularity, and, what is of greater importance, more effectually protect the iron boiler. To get good results with any of them, the most scrupulous care must be exercised in their formation and in their examination while in work. A fracture, which would allow the bisulphite liquor to penetrate to the shell will cause corrosion of the plate sooner or later, and, therefore, the interior must be examined periodically. The brick or tile and sulphate of lime linings also act as non-conductors of heat. They, therefore, assist greatly in the economy of fuel and in preventing the undue dilution of the liquor within the digester.

* From *The Chemical Trade Journal.*

TUNNELS NEAR NEW YORK CITY.

DAYLIGHT broke through the tunnel of the New York, Susquehanna and Western Railroad Company, under Weehawken Heights, for the first time lately. That does not mean, however, that the tunnel is completed, but merely that the "heading" or upper part of the tunnel has been "drifted" through from end to end, preparing the way for excavating the "bench" or lower part. The object of this tunnel is to enable the company to reach the river front without running its trains over the tracks of other roads. At present the company's passenger trains run over the Pennsylvania Railroad Company's tracks from Marion to Jersey City, and its coal and freight trains over the Delaware, Lackawanna and Western Railroad Company's tracks from West End Junction, beyond Marion, to Hoboken. In order to secure its own terminal on the Hudson River, the company, a few years ago, acquired sixty acres of land in the village of Edgewater, about two miles north from Weehawken and opposite One Hundred and Tenth Street. This land has a frontage of 1,500 feet on the river, and affords ample room for handling a large number of trains daily. Then the tunnel was projected to connect the terminal with the main line at Little Ferry Junction, ten miles from Jersey City and three miles almost due west from the terminal at Edgewater.

The tunnel is 5,072 feet long, 21 feet high to the crown of the arch and 28 feet wide, giving ample room for double tracks. The estimated total cost of the tunnel, including the three miles of double track to Little Ferry Junction, the sixty acres of land, two piers which are being built and the necessary switches and sidings at the terminal, is $1,700,000.

When the tunnel is completed only the freight and coal trains will be run through it to the river at first, but ultimately ferry slips will be constructed and passenger trains will run through it, and the passengers will be transferred to this city by boats. Ground was broken for the tunnel on August 1, 1892, and since then about 900 men have been employed in its construction, while about 150 have been engaged in building the piers, etc., on the river front. The tunnel, the three-mile spur of railroad and the terminal will be completed about June 1.

The first step in the construction of the tunnel was to sink three vertical shafts, at equidistant points, from the surface of the Palisades to the grade of the tunnel. These shafts are each ten feet long and twenty feet wide, the greatest depth being 196 feet. When the shafts had been sunk, two gangs of workmen in each began "drifting," or excavating in opposite directions, to meet the gangs which were "drifting" toward them from the other shafts. The "heading" or upper section of the tunnel is eight feet high, and was bored entirely through rock. In "drifting," steam drills are used. Six or eight holes converging to a point are drilled and charged with explosives. These holes are from six to eight feet in depth, and are charged with dynamite, giant powder and other explosives. When the blast occurs an immense wedge-shaped piece of rock is thrown outward into the part of the tunnel already excavated, removed on a temporary tramway constructed for the purpose and hoisted to the surface through the shafts by steam elevators. The blasting out of the wedge-shaped rock leaves a hole six or eight feet deep or long in the center of the tunnel, so that space is provided for receiving the fragments of rock afterward blasted from the sides, which is done in the same way, except that the holes are drilled parallel with the direction of the tunnel, which runs almost exactly east and west.

The upper part or heading having been completed, the excavation of the bench or lower part, which is thirteen feet high, is comparatively easy, as, instead of having to work laterally, the drilling and blasting are done vertically from above downward. Throughout the entire length of 5,072 feet arching was found necessary for a distance of only about 300 feet, the rock being sufficiently solid to serve as a natural arch.

The arching is of brick and cement, three feet thick, which means nine courses of brick laid on edge. The distance necessary to be arched is remarkably small, especially when compared with that of other tunnels under the Palisades. The tunnel of the West Shore Railroad Company at Weehawken is 4,200 feet long, and about 50 per cent. of it is arched, while of that of the Delaware, Lackawanna and Western Railroad Company at Hoboken, which is 4,600 feet long, about 75 per cent. is arched. The portals of the new tunnel will be handsomely faced with cut red sandstone.

While the tunnels under the Palisades are of great utility, they become insignificant when compared with many other much longer ones in this country and Europe, which are at a much greater depth. The Hoosac Tunnel, in Western Massachusetts, is four and three-quarters miles long, and its principal working shaft was 1,028 feet deep.

Early in the work of its construction the heavy timber braces which were used to support the earth and rock during the building of arches were burned, causing the loss of twenty lives and the obstruction of the tunnel for a considerable time. The St. Gothard Tunnel, in Switzerland, is over nine and a half miles long, and the Mont Cenis Tunnel, in Italy, is seven and one-quarter miles long.

THE EAST RIVER TUNNEL.

The construction of the East River Tunnel is going on rapidly. This tunnel was projected by the East River Gas Company, of Long Island City. This company now supplies the gas used in that city. It has a gas plant at Ravenswood, L. I., opposite Seventy-first street, which it is rapidly enlarging, with a view of supplying gas not only to private consumers in this city, but also to the gas companies by whom they have hitherto been supplied. To facilitate this, a cylindrical subaqueous tunnel for its mains, composed of plates

of iron securely bolted together, was planned, and about 650 feet of it has already been completed. The tunnel will run from Ravenswood to East Seventy-first Street, passing under Blackwell's Island, near the middle of the island. It will be 2,500 feet long and ten feet in diameter. The work was begun about eighteen months ago by sinking working shafts at both ends of the line.

The shaft in this city is 147 feet deep, and that in Ravenswood 134 feet deep. Each is sixteen feet in diameter, and each has a powerful steam elevator for hoisting out the excavated material. When the level of the proposed tunnel was reached, then began the difficult and dangerous subaqueous tunneling through soft mud, 124 feet below the river's surface and 60 feet below its bed. The old style of driving a subaqueous tunnel involved the use of large quantities of heavy timbers, and was extremely unsatisfactory. In driving a top heading, steel roof plates were put in. These were ⅛ inch thick, 3 feet long and 1 foot wide, and rolled to a curve corresponding with the curvature of the tunnel. After the heading had been driven about twenty feet, a mud sill, being a heavy, yellow pine timber, twelve inches square, was introduced, and wooden braces resting on this supported the roof and sides of the tunnel, the braces radiating from the timber like spokes from the hub of a wheel. The tunnel was then excavated for about ten feet, the brick work introduced and the operation repeated.

Chief Engineer Walton I. Aimes, who is constructing the East River Tunnel, and who was engineer in charge of the construction of the Hudson Rivel Tunnel, has invented a new method of subaqueous tunneling, which he is now using in boring the East River Tunnel. This consists of a cylindrical shield made of steel plates, and is of a little larger diameter than the tunnel. Its forward end is closed by massive iron plates, but has four small iron doors, which may be opened when necessary. This shield, in which the men work, is pushed forward through the soft mud by means of twelve hydraulic jacks, each of which exerts a pressure of 5,000 pounds to the square inch, or fifty tons each, making 600 tons for all. This tremendous pressure compacts the material ahead of the shield, so that it may be readily excavated. The water is excluded and the walls of the tunnel sustained against external pressure during their construction by compressed air, and the workmen enter and leave the tunnel through air-locks.

The air pressure in the East River Tunnel is forty-eight pounds to the square inch, while that in the caissons underlying the towers of the Brooklyn Bridge and used in their construction was only forty pounds. Some difficulty is experienced in procuring workmen, as many are unable to endure this pressure. The men are paid $3 each a day, and are required to undergo a medical examination before they are employed. Only sound and robust men are accepted, as men who have heart trouble and some other maladies would inevitably be killed. Four men have thus far been killed by the air pressure in this tunnel. The best men can work only two hours at a time in the tunnel, which is lighted by electricity. Then they work two hours on the surface, and, returning to the tunnel, work two hours more, making six hours in all, which is regarded as a full day's work. The men who have lost their lives are said to have been victims of their own carelessness in coming too quickly from a high artificial pressure to the lower normal pressure, when they were seized with bleeding from the mouth, nose and ears, and quickly collapsed. The number of experienced tunnelers now employed is about fifty.

The plates composing the walls of the tunnel are of cast iron, one and one-fourth inches thick, sixteen inches wide and three feet long. Their edges are angled, or flanged, so that they may be securely bolted together, and the joints are perfectly water-tight. The flanges, when bolted together, are like the ribs of a ship and give strength to the walls. In preparing to put the plates in position the shield is pressed forward into the mud a distance of about twenty inches, and a rear projection or flange of the shield excludes the mud while the plates are being bolted together. When one course of plates has been secured the shield is again moved forward and the next course of plates is placed in position, and so on. In this manner about five feet of the tunnel are completed daily. Blackwell's Island is now only about 175 feet from the shield, and when it is reached it is expected that ten feet of the tunnel will be completed daily, as drifting through rock and earth is much easier and simpler than the work now in progress.

The strata through which the tunnel has been bored have yielded many beautiful specimens of pyrites in almost perfect crystallization. These were embedded in a black, coal-like substance, resembling peat, and indicating that a point sixty feet below the bed of the river and 124 feet below its surface was formerly high and dry and covered with vegetation. Corresponding progress is being made at the other end of the tunnel, which, it is expected, will be completed early next summer. The company has already laid about twenty-five miles of gas mains in this city, and the work is still going on.

The fact that the gas works in this city are situated in densely populated districts, and that sooner or later, for obvious reasons, those works will have to be abandoned, induced the East River Gas Company to begin building the tunnel and enlarging its works at Ravenswood, with a view of ultimately manufacturing and supplying all the gas consumed in this city. The companies by which gas is now supplied in this city are the Consolidated, Equitable, Mutual and Standard. In recent years the use of naphtha has been in a large degree substituted for coal in the manufacture of gas by the local companies, which makes its production not only disagreeable to people who live near the gas works, but also dangerous. About 1,000,000 barrels of naphtha are annually used in the manufacture of gas in this city. The enlarged works of the East River Gas Company will have a capacity for producing 50,000,000 cubic feet of gas a day, which is 10,000,000 feet in excess of the quantity now consumed in this city. President McMillan, of the East River Company, says it will not be a long time before the manufacture of gas will be prohibited in this city, but that when the company's ambitious plans shall have been carried out, the company will be able to supply all the gas required and at a reduced price, as one company with large works can manufacture much more cheaply than several companies with small works.

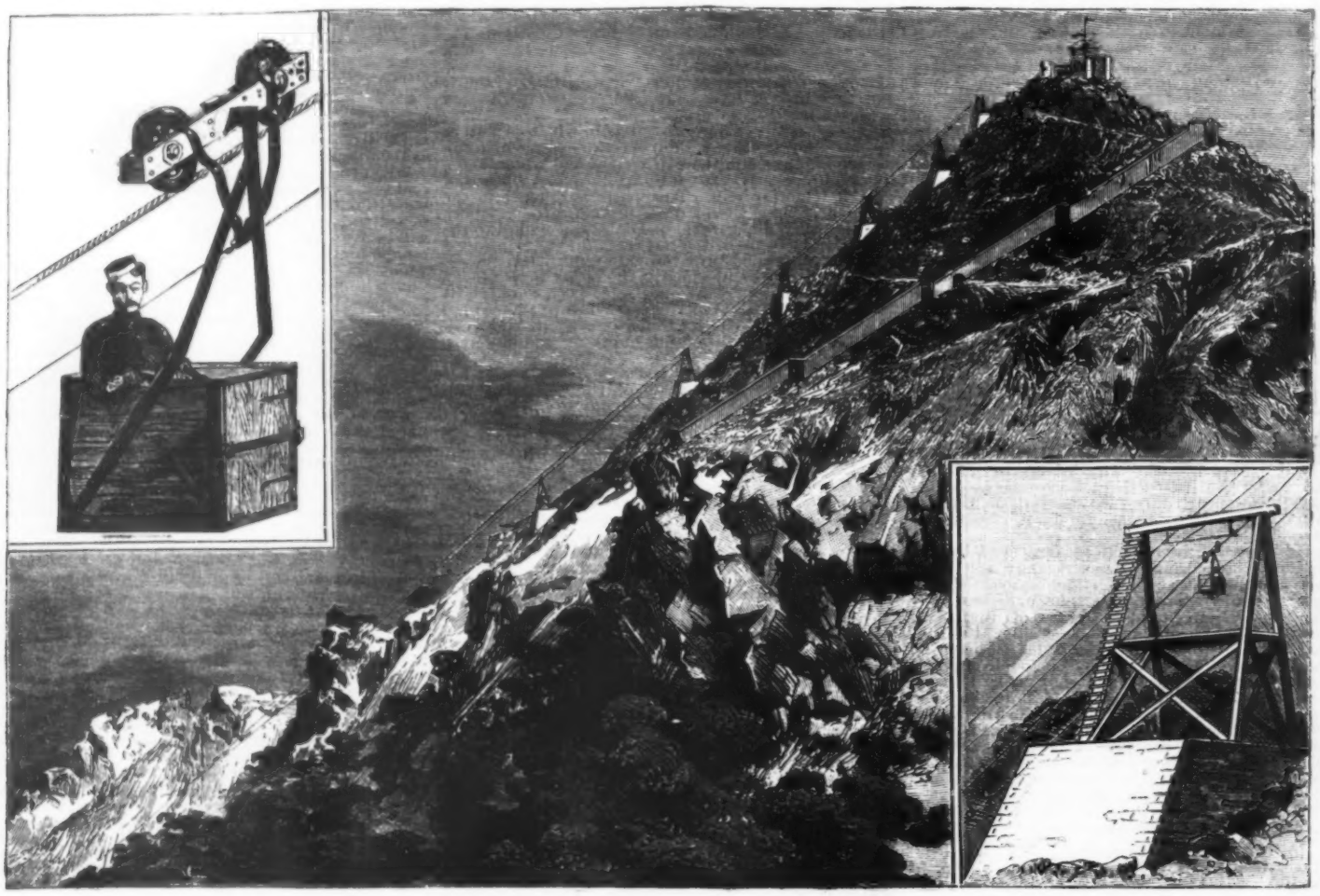
THE HUDSON RIVER TUNNEL.

Work on the Hudson River Tunnel, to extend from Fifteenth Street, Jersey City, to Morton Street, in this city, was suspended in 1892, through lack of funds for carrying it on. The plans for the undertaking contemplated a tunnel of eighteen feet diameter, in the clear, and 5,600 feet long. At Morton Street an underground railway terminal was to be constructed, and not only passenger trains, but also freight trains of every kind, were to run through the tunnel into this city. Cold storage warehouses were to be erected above the terminal for the reception of meat, etc. The construction of the tunnel was begun by a private company in 1878. Up to 1890 there had been 2,000 feet finished, and from then until work was stopped in 1892 there were 2,000 feet more constructed, so that only 1,600 feet remains to be built. The Tunnel is composed of cast iron plates, like those of the East River Tunnel. The cost of construction was $300 a lineal foot, or a total of $1,080,000, which is only about one-tenth of the estimated cost of a suspension bridge over the Hudson River.

In 1880, when only about 100 yards of the tunnel had been completed, it was suddenly flooded by the bursting in of the water of the river, and twenty workmen were drowned. The last work done on the tunnel was paid for with English capital. A meeting was recently held in London to devise means for providing about $1,000,000 needed to complete the tunnel and terminal, but nothing was done, as the construction company has a lien on the unissued bonds. It is believed, however, that the requisite funds will soon be provided, and the tunnel and terminal completed.

The tunnels of the world are classified as railroad tunnels, which are bored through earth and stone

A Passenger in the Car of the Aerial Railway.



One of the Trestles which Supports the Aerial Railway.

THE AERIAL RAILWAY AT GIBRALTAR.

above the level of the sea; subaqueous tunnels; canal tunnels, by means of which the courses of the canals are straightened by boring through hills or mountains; and conduit tunnels, which are used for conveying water by its own gravitation. There are in the world about 1,000 railroad tunnels, which are about 350 miles long; 12 subaqueous tunnels, 9 miles long; 90 canal tunnels, 70 miles long and 40 conduit tunnels, 85 miles long. Approximately, there are in the world 1,142 tunnels of all kinds, having a total length of 514 miles.—*N. Y. Tribune.*

THE AERIAL RAILWAY AT GIBRALTAR.

FROM the day when Gibraltar was captured by Admiral Rooke, in 1704, the art of the engineers has been constantly employed in strengthening the naturally powerful defenses of this mighty fortress, which at the present time is considered as "impregnable." A recent and important addition to these is the aerial railway which now connects the signal station with the south end of the town. By means of it *materiel* of all kinds—formerly conveyed in carts by a steep and tedious route—is now transferred to the summit of the rock in less than five minutes. At the north end of the Alameda is the engine house, from which two cables rise, with a stretch of three hundred yards, as far as the edge of the cliff. Above this point the convex shape of the rock necessitated their being raised to the required height from the ground by means of huge trestles. The longest wire span in Europe (unsupported between the ends) is that of a similar railway in the Pyrenees, no less than 1,200 yards in length. A powerful horizontal engine works the hawsers connected with the two

cars, pulling the one up and the other down simultaneously. Although, to those ignorant of the laws of gravity, an ascent appears to be fraught with peril, there is not the least danger of the cars overturning or the cables breaking. The latter, though capable of resisting a strain up to seventy tons, are not required to carry a load of more than one-twelfth of that weight. The peak on which the signal station stands has for centuries past served for the same purpose, as is shown by its Spanish name "El Hacho," which means a faggot saturated with pitch—the "balefire" of olden times.

Our illustration is from a sketch by H. Rose, Lieutenant Black Watch, Gibraltar.—*The Graphic, London.*

THE CYCLE EXHIBITION AT PARIS.

THE first cycle exhibition ever organized in France is now open. Although it cedes in no respect to those of our neighbors, the English, we must, nevertheless, state that we are, unfortunately, far behind them, since biennial exhibitions known by the name of Stanley shows and national shows have taken place regularly for the last fifteen years in England.

The *Salon du Cycle* is installed in Wagram Hall, and its legitimate success does the greatest honor to its organizers, and especially to Mr. Bivort, who was the first to conceive the idea of it and to have the courage to put it into execution.

More than two hundred exhibitors have responded to his call, and all seem to have striven with good taste and elegance to have their stands prove as attractive as possible to the visitors.

Among the rich fabrics and chatoyant velvets with fringes of gold with which the stands are draped, the bicycles and machines of varied types, enameled and brightly nickel plated, vie with each other in lightness, elegance, precision and finish.

The pneumatic tire machines are in special favor with the public, and the eager crowd listens attentive-

THE PARLOR CYCLE.

ly to the demonstrations that the manufacturers make of their various systems, which are less liable to crack and are more elastic, lighter and more easily detachable than any other!

Among so many attractions we have noticed some that constitute genuine novelties.

The Valere bicycle is, beyond a doubt, the hit of the exhibition, and its inventor offers something that is really new. He has attacked the solution of the hardest problem in cycling—the simultaneous utilization of the arms and legs for the propulsion of machines.

The innovation has raised quite a controversy in the velocipedic press. However this may be, the results obtained are too convincing to permit Mr. Valere's tentative to be treated as visionary.

We have before our eyes an indisputable document—a bulletin of the experiments made at the Department of Agriculture (*Section of Machines*) whence it results that the rendering of the apparatus under consideration is greater by half than that of our best machines.

It is, in fact, beyond doubt that the alternate use of the arms and legs can lead only to manifold advantages, in regularly and systematically developing the muscles and in better distributing the work to be furnished, thus preventing the overdriving of a single organ.

The Valere bicycle is provided in front with two large levers jointed to the frame, and which, through the intermedium of connecting rods at the lower part, help work the cranks moved by the feet. In action, while the right leg, for example, is moving forward, the left arm is effecting a motion in the opposite direction in pulling its corresponding lever. There is a simultaneous and contrary stress of the arms and legs—a motion of repulsion of the one and of traction of the other. The two forces, therefore, act fully in making use of each other mutually as a point of support.

The similitude of the motions with those of a person running is striking, and this well justifies the name of "running machine," given by the inventor.

In this bicycle the balancing and steering are effected through a system of rods and levers actuated by handles. It suffices, in running, to oblique these more or less in order to steer the apparatus. The arrangement is complicated, and that is the only weak point of the machine.

The "Valere" is essentially rapid, or "quick," according to the popular expression. The road model exhibited makes eight meters per revolution, and that, too, it appears, without occasioning any more fatigue, while ordinary bicycles cover but five meters per revolution of the pedal.

For the future, such a result may allow fantastic speeds of 60 kilometers per hour to be foreseen in races! But is this machine practical?

The steering of it, which is a somewhat delicate matter, will require some little practice; and will not the falls that are so common with bicycles be attended with serious injuries to its so complex parts? So the

THE RUNNING MACHINE.

tricycle established according to the same order of ideas is unquestionably preferable to it.

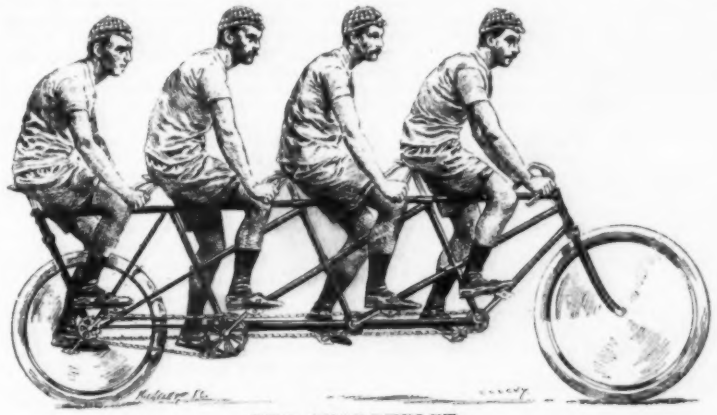
The running machine has not alone the monopoly of speed, for we find, likewise, at the exhibition a bicycle that makes its eight meters per revolution of the pedal, but let us add that it is ridden by four persons. It is the "Quadruplet." It is nearly three meters in length, and its weight, inclusive of that of the riders, is 300 kilogrammes. The pedals, set in the same direction, give an intensity of action similar to that of a crew of oarsmen. Under such an impulsion the machine acquires a vertiginous velocity.

The Quadruplet is too new to make it possible to consider its future. Up to the present it has served rather as a training machine, especially in England, where it has permitted of lowering short distance records (one mile or a half a mile) by a few seconds.

It was at the time of the recent match between Corre and Stephane that the first model constructed in France made its appearance, but the inexperience of the racers called upon to steer this new machine, designed to carry the two matchers, and the slight solidity of the flooring of the track, which threatened to give way under its weight, caused it to be immediately retired from the race.

Who would dare assume the responsibility of allowing such machines to run upon a roadway at speeds capable of reaching, at times, more than forty kilometers per hour? What terrible consequences to be considered in case of accidents, falls or collisions rendered almost inevitable, seeing the difficulty of steering surely at such velocities!

Alongside of the machines that develop the greatest speed, it is interesting to present by antithesis, so to speak, those that give the least. In the first place, it is a tricycle whose movement is combined for obtaining a minimum of effect. Devised by Mr. Meyan, it is to be used upon the new ring of the Eden theater for



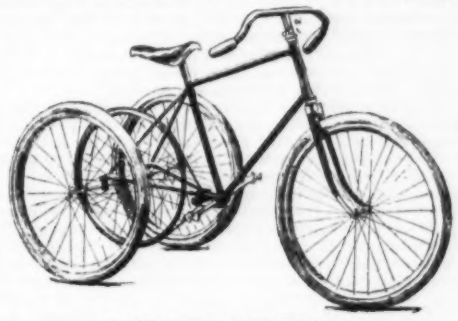
THE QUADRUPLET.

races that may be qualified as paradoxical. Without having any analogy with sport, they will nevertheless not be devoid of attraction. Here, the space covered per revolution of the pedal is no more than fifteen centimeters! One may judge in imagination of the fantastic efforts necessitated for recovering from a competitor an advance of fifty centimeters; of the incredible energy, as well sustained as in one of our best champions, that it will require to obtain a speed of three kilometers per hour; and of the spirit of the final spurt at the home pole in order to beat an adversary by a few centimeters! In a word, it is a parody upon our actual races.

Contrary to what is found in ordinary tricyles, in which the cranks actuate a large sprocket wheel that transmits the stress, through a chain, to a smaller sprocket wheel, fixed to the axle of the driving wheels, it is a small sprocket wheel here that actuates a large one nearly equal, in diameter, to the wheels of the machine. Owing to the slight velocity that results from such an arrangement, the system, by reason of the instability of equilibrium, can be applied to tricycles only.

Who would have said that cycling would prepare for us striking contrasts? After putting in parallel for us the swiftest and the slowest machines, it offers us the "Veloroom," an apparatus upon which a person, while exerting the same stress as before, remains *in situ*. It is, as its name is intended to indicate, a parlor cycle. As the saddle, pedals and handle bar are fixed to a frame mounted upon a support, the results are wholly Platonic. There are no overthrows to be feared, no risks to be run, the equilibrium is stable and the danger is *nil*, for the most furious kicking of the pedals produces no influence except upon the needle of a kilometric counter that mechanically registers the distance that would have been made in reality. So the apparatus appears to recommend itself more particularly to persons by whom, on account of obesity, the use of any bicycle or tricycle whatever is rendered impossible.

Specialized in cycling, the new home trainer may,



SLOW SPEED TRICYCLE.

during the inclement season, prove an excellent training instrument for racers.

Upon the whole, the exhibition presents to us four novelties, contrary to each other as to results, and that are destined to show their capabilities this year.—*L'Illustration.*

[Continued from SUPPLEMENT, No. 950, page 15177.]

THE ART OF BOOK AND NEWSPAPER ILLUSTRATION.*

By HENRY BLACKBURN.

Lecture II.

LAST week we saw on the screen a number of enlargements of drawings which had been reproduced successfully by the common relief processes, suitable for the type press. The most interesting and suggestive to students were those drawn by painters, each adopting his own method of expressing, in black and white line, the effect and spirit of his picture. The result in most cases showed a freedom of handling, and an unconventional treatment of line drawing to give tones and values, in striking contrast to the majority of process work. Some of these were only sketches, and on various kinds of paper or board; but the artists knew what they wanted to express, and took the readiest and simplest method to attain it. They had dwelt for months on their subject, they knew the picture by heart, as the saying is; hence the value to us of their suggestive lines. These drawings (examined with the results when reproduced) form together, I believe, the soundest teaching in black and white work.

Let us now look at a pen drawing by Mr. H. S. Marks, R.A., and explain shortly the method of its reproduction. This drawing [here enlarged on the screen] was about 7 in. by 5 in.; it is thoroughly suitable for reproduction on a much smaller scale (say 3 in.) if necessary. Here every line tells, and none are superfluous; the figure of the monk, the texture of his dress, the door behind him, and the grass growing between form a picture, the lines of which harmonize well with the type of a book. In this deliberate, careful drawing, in which white paper plays by far the principal part, the lighting of the picture is considered, and the balance of a decorative page; a scientific example of the art of leaving out—of "the value of a line."†

Drawings thus made, upon Bristol board or paper

* Three lectures delivered before the Society of Arts, London, December, 1893. From the *Journal* of the Society.

† The young "pen and ink artist" avoids backgrounds, or renders them by a series of unmeaning scratches; he does not consider enough the true "lighting of a picture," as we shall see further on.

of that surface, with black ink, Indian ink, or any of the numerous inks now in use, which dries with a dull, not shiny, surface, will always reproduce well. The pen should be of medium point, or a brush may be used as a pen. The lines should be clean and sharp, and are capable of much variation in style and treatment, as we saw in the various examples last week. I purposely do not dwell here upon some special surfaces and papers by which extraordinary effects may be produced sometimes by the line processes; there is too much tendency already with the artist to be interested in the mechanical side.

PHOTO-ZINC PROCESS.

Now, to turn the drawing before you into a suitable block, the first process is to photograph it to the size required (say 5 by 4), and transfer the negative on to a sensitized zinc plate. This print or photographic image of the drawing lying upon the zinc plate is of greasy substance (bichromate of potash and gelatine), and is afterward inked up with a roller; the plate is then immersed in a bath of nitric acid and ether, which eats away what were the white parts on the paper, leaving the lines of the drawing in relief. This "biting in," as it is called, requires considerable experience, according to the nature of the drawing. Thus the lines are turned into metal in a few hours, and the plate, when mounted on wood to the height of type letters, is ready to be printed from, if necessary, at the rate of several thousands an hour.

The best drawing for process reproduction is one that requires little or no touching on the part of the engraver or maker of the blocks; but it is difficult to impress on the artistic mind the necessity of conforming to certain rules. Some cannot draw firm, clean lines at all, and *should not attempt them.* Few allow sufficiently for the result of reduction, and the necessary thickening of some lines.* The results are often a matter of touch and temperament. Some artists are naturally unfitted for line work; the rules which would apply to one are almost useless to another. Again, there is a great inequality in the making of these cheap zinc blocks, however well the drawings may be made; they require more care and experience in developing than is generally supposed.

GELATINE RELIEF PROCESS.

Let us look now at the enlargement of a line drawing which is more difficult to reproduce; a portrait by the late Frank Holl, R.A. (drawn on Whatman paper, 4½ in. by 3½ in.), in which there are many pale, uncertain, and complicated lines which could not be produced well by the process just described. Here a more delicate and sensitive method is necessary to obtain a relief block. It is called the "gelatine process," or the "Gillot process."

The drawing is photographed to the required size (as before), and the *negative* laid upon a glass plate (previously coated with a mixture of gelatine and bichromate of potash). The part of this thin, sensitive film exposed to the light is absorbent, and when immersed in water swells up. The part protected from the light by the lines of the drawing remains near the surface of the glass. Thus you have a negative from which a metal cast can be taken, leaving the lines in relief as in the zinc process. In skillful hands this process admits of more delicate gradations, and the pale, uncertain lines in the drawing before us can be reproduced with tolerable fidelity. The blocks take longer to make, and are double the price —roughly, 1s. per square inch—of the first process described. There is no process yet invented which gives better results from a pen and ink drawing for the type press. These blocks when completed have a copper surface. The reproductions of pencil, chalk, or charcoal drawings by the above processes are nearly always failures, as we may see in the best artistic books and magazines to-day. I will refer to them presently.

For those who cannot draw easily with the pen, there are several kinds of grained papers which render drawings suitable for reproduction. The first is a paper with black lines imprinted upon it on a material suitable for scraping out to get lights, and strengthening to get solid blacks. The drawings thus made can be reproduced in relief like line drawings, taking care not to reduce the black grain much or it becomes "spotty." Another paper largely used has a white grain, a specimen of which I will show you presently on the screen; and there are other variations of grained papers on which we will not dwell †

Here the question may arise in many minds, Are these contrivances, with their mechanical lines for producing effect, worthy of the time and attention which has been bestowed upon them? I think it is very doubtful if much work ought to be produced by these means; and certainly in the hands of the unskilled, the results would prove disastrous. A painter may use them for sketches. Mr. Compton, as you see, can express very rapidly, by scraping out the lights and strengthening the darks, a snow drift or the surfaces of a glacier. The late C. J. Watson and the French artist, M. Bistagne, have shown us how the white grained paper can be played with, in artistic hands, to give the effect of a picture in a quarter of an hour. [Reference to enlargements on the screen.]

MECHANICAL DOTS.

The increased use of mechanical dots to give shadow and color to a pure line drawing is always to be regretted, whether it be applied to a necessarily hasty newspaper sketch or to one of Vierge's handsomely printed illustrations for the "Pablo di Segovia." One cannot condemn too strongly this system, so freely used in Continental illustrated sheets, which, in the most skillful hands, seems a degradation of the art of illustration. These dots and lines, used for shadow or tone, are laid upon the plate by the maker of the block, the artist indicating, by a blue pencil mark, the parts of a drawing to be so manipulated; and as the illustrator has not seen the effect on his own line drawing, the results are often a surprise to every one concerned. I wish these ingenious contrivances were more worthy of an artist's attention. Nothing but the speed with which a sketch for a newspaper can be thus made seems to excuse its use. Hurry is the secret and the mischief of it all.

Here is an example taken from an English print, by which you see that all daylight has been taken ruthlessly from an open air sketch. The system is tempting to the hurried illustrator; he has only to draw in line (or outline, which is worse), and then mark where the tint is to appear; and the dots are laid on the zinc plate by the maker of the blocks.

In the enlargements before you (referring to two examples from the *Daily Graphic*, one partly and one wholly covered with dots) it will be obvious that the artist's sketch is injured by this treatment, that in fact the result is not artistic at all. Nothing but high pressure or incompetence on the part of the illustrator can excuse this mechanical appliance to an incomplete drawing. Again I must remind you that these results are not the fault of the "process," or of the "process man." But the system is growing in every direction to save time and trouble, and is lowering the standard of topical illustrations. And it is this system (*inter alia*) which, I believe, is to be taught in technical schools, where the knowledge of process is taking the place of wood engraving.*

The question is again uppermost in the mind, are such mechanical appliances ("dodges," I venture to call them) worthy of the serious attention of artists; and can any good arise in imparting such knowledge to youthful illustrators in technical schools? Wood engraving was a craft to be learned, with a career for the apprentice. *There is no similar career for a lad by learning the "processes" at technical schools;* and nothing but disappointment before him if he learns the mechanism before he is an educated and qualified artist.

It should be mentioned that all wood or steel engravings reproduce easily by the common zinc line process, but the reproductions are apt to lose brightness, and if much reduced break up or become spotty. Mention should be made also of drawing on prepared transfer paper with autographic ink, which is transferred to zinc without the aid of photography, a process very useful for rapid and common work; but it is irksome to the artist and not capable of very good results; moreover, the drawing has often to be minute, as the reproduction has to be the same size as the original.

HALF-TONE PROCESS.

I now come to the method of reproducing wash drawings and photographs; on blocks suitable for printing at the type press, commonly known as the Meisenbach or "half-tone process;" a most ingenious and valuable invention, which, in clever hands, is capable of artistic results, but which in common use has cast a gloom over our illustrations in books and newspapers.

Now, to make these blocks; as there are no lines or whites in a painting, or from a photograph from nature, it is necessary to obtain some kind of grain, or interstices of white, on the zinc plate, as in a mezzotint. So between the drawing or photographic print to be reproduced and the camera, glass screens, covered with lines or dots, are interposed, varying in strength according to the light and shade required; thus turning the image of the wash drawing practically into "line," with sufficient interstices of white for printing purposes.

Thus, all drawings in wash, chalk, pencil, etc., that will not reproduce by the direct line processes, already referred to, are treated for printing at the type press, and thus the uniform, monotonous dullness with which we are all familiar pervades the page.

The artist who draws in wash with body color, or paints in oils in monochrome, for this process, will see at once that his high lights will be lost, and his strongest effects neutralized, under this effect of gauze; in short, that there is no longer any breadth of white or black in his picture; and so for pictorial purposes, the illustrator who draws in wash has to *force his effect*, and exaggerate his lights and shades, avoiding too delicate gradation; and in his different tints keeping, so to speak, to one octave instead of two. Thus, also for this process, to obtain brightness and cheap effect, the illustrator of to-day often avoids backgrounds altogether.

Some excellent results (which I will show you presently on the screen) may be obtained by experienced and practiced draughtsmen, if their work is well reproduced with a fine grain, and printed carefully on good paper. But where the block has to be prepared for printing, say 5,000 an hour off rotary machines, a coarser grain has to be used, producing the "Berlin wool pattern" effect you see before you.

There are many ways by which drawings unsuitable for the relief-toned processes are made available. Great advances have been made in the "screening" of pencil drawings where a great deal of white has to be left. You may trace the screening on every part of the enlarged proof before you. [Reproduction of a pencil sketch by Mr. Melton Prior.] These two wash drawings by Mr. S. Begg and Mr. Greville Manton, which have appeared lately in the *Black and White* newspaper, are good examples of the way to draw for reproduction; the artists have, you will notice, met the process half way, they have been careful to use broad, clear, firm washes, and they have done them with a certain hand, the result of experience. If, in the endeavor to get the best results out of a few tones by the mechanical process, their work lacks some artistic qualities, it is almost a necessity; but the tendency of this most modern form of illustration is to think too much of *technique.* But with the utmost care and patience on the part of the artist, these wash drawings, rendered by the half-tone process, are uncertain and artistically incomplete. It is more suitable for the rendering of sketches. Of the illustrators who use this process in a more free and easy way we will now take an example [an enlarged wash drawing was shown upon the screen].

Here truths of light and shade are disregarded, figures stand out in unnatural blackness against white paper, and flat mechanical shadows are cast upon nothing. Only sheer ability on the part of a few modern illustrators has saved these course ungainly sketches from universal condemnation. But the splashes, and spots, and stains, which are taking the place of more serious work in illustration, have become a vogue in 1893. The sketch is made in two or three hours, instead of a week; the process is much cheaper than wood engraving. The public is satisfied with a sketch where formerly a finished illustration was required, if the subject be treated dramatically and in a lively manner. If it comes out an unsightly smear on the page, it answers the purpose of topical illustration, and apparently suits the times. It is scarcely too much to say that this example would not have been tolerated a few years ago. But it is the taste of the times to which the modern illustrator has adapted himself; and it is little short of a revolution in illustration, of which we do not yet see the end. One thing we must continuously bear in mind, that these hastily produced blotches called illustrations, which disfigure the pages of so many books and magazines, are the result of want of care on the part of the artist rather than of the maker of the blocks. The latter are, according to my experience, the most patient and painstaking of operatives.

The result of all this—a very serious one to the artist as far as we can see ahead—is the gradual substitution of photographs from life for any other form of illustrations. The Meisenbach reproduction of a photograph I now show you [the full length figure of the lady mayoress, photographed by Messrs. Russell, of Baker street] answers the purpose of the editor of a newspaper to fill a page of his paper, where formerly artists and engravers would have been employed. The excuse for it is that the details of the dress are so well rendered on the block as to answer the purpose of a fashion plate, apparently a most important matter.

Now let us see what becomes of a very artistic photograph when put through the half tone process. Here is the photographic print from a painting by M. Jules Lefebre [portrait of girl reading, shown on the screen]. This excellent silver print, full of delicate gradations and strong effects, appears on the plate through the film of gauze, dull, flat, and comparatively uninteresting; but the expression of the original is given with more fidelity than could be done by any ordinary wood engraving. To touch this on the negative and bring out the lights and accents of the picture is the common thing to do by the makers of the blocks; but it is a hazardous process at the best, when dealing with the copy of a painting. I mention it to show where handwork in the half tone process first comes in. The block, when made, is also often touched up by an engraver in places, especially where spotty or too dark; on this work many who were formerly wood engravers now find employment.

But the ideal illustration by process, whether from a line drawing, wash, or photograph, it cannot be repeated too often, is the one which requires the least manipulating on the part of the maker of the block, who has seldom, or never, the opportunity to attend to it properly. In the case of the reproduction of photographs, especially, which we are now considering, much may be done by working up a platinotype before giving it out to be made into a block. Much depends here upon the artistic knowledge of editors and publishers, who have it in their power to produce good or bad illustrations from the same original. The makers of these blocks being confined to time and price, are practically powerless.

Here let us pause for a moment to consider the material of which one number of an illustrated paper (*Sketch*) is made up, and how far the artist and wood engraver has part in it. It will be instructive from an economic point of view. I take a copy of *Sketch* because it is a typical and quite "up to date" publication, vying, in circulation and importance, with the *Illustrated London News*, both published by the same proprietors. In one number there are upward of 30 pages, 10 being advertisements. There are in all 151 illustrations, of which 63 appear in the text part and 88 in the advertisement pages. Out of these text illustrations, 24 are from original drawings or sketches. Next are 26 photographs from life (several being full pages), and 13 reproductions from old engravings, etc., reproduced by mechanical processes—in all 63. Some of the pages reproduced from photographs are undeniably good, and interesting to the public, as is evidenced by the popularity of this paper alone. In the advertisement portion are 88 illustrations (including many small ones), 85 of which have been engraved on wood; a number of them are electrotypes from old blocks, but there are many new ones every week. The reason for using wood engraving largely for advertisements is, that wood blocks print more easily than "process," when mixed with the type, and print better (being cut deeper on the block) where inferior paper and ink are employed. But this class of wood engraving may be summed up in the words of one of the craft to me lately: "It is not worth £2 a week to anybody." (I will refer to the better class of wood engraving when speaking of books next week.)

Thus, it will be seen that, in the "text" part of this newspaper, two-thirds of the illustrations have been produced without the aid of either artist or engraver!

To turn to other subjects where the photographer is the illustrator. The photographer goes down a mine with his apparatus, and takes a series of views of the workings, which could probably have been done by no other means. Under most difficult circumstances he sets his camera, and by the aid of the magnesium flash-light gives us groups of figures at work amid gloomy surroundings. Whether these are not both artistic and valuable as illustrations I leave you to judge. [Here two slides, taken in the Cambrian lead mines by Mr. J. C. Burrow, of Camborne, were shown, and others were exhibited on the walls.] The remarkable part, artistically, is the good color and grouping of figures. One great value of these illustrations consists in the clear

* All drawings for reproduction should be marked in the margin by the artist as to the amount of reduction intended. It is a useful guide to all concerned in publication.

† Mr. C. G. Harper, in his excellent book on "English Pen Artists," has treated of other ways in which drawings on prepared papers may be manipulated for the type press.

* The rendering of a chalk or pencil drawing into a relief block, to be printed on rapid machines with inferior paper and ink, is another branch of process which I think the student of art had better not know much about, for the process has never been successful under the best conditions. He would be better occupied in learning drawing on stone, an art which does not come into the scope of these lectures, as it is seldom used in book illustration and cannot be printed at the type press.

It is well worthy of study now, for the art is being revived in England on account of the greater facilities for printing than formerly. It is possible to obtain excellent results from chalk and pencil drawings in intaglio; photographed and printed as a copper plate; as may be seen in the specimens by the Autotype Company on these walls.

definition of detail. These photographs are shortly to be published in a book by Mr. Burrow and Mr. Thomas.

Another instance of the use of photography in illustration. Mr. Frederick Villiers, the special artist at Chicago for the *Black and White* newspaper, made a startling statement lately in this room. He said that out of some 150 subjects which he took in Chicago not more than half a dozen were drawn by him; all the rest being "snap shot" photographs. Some were very good, could hardly be better, the result of many hours' waiting for the favorable grouping of figures. That he would redraw some of them with his clever pencil for this newspaper is possible, but observe the part photography plays in the matter. I could mention many instances where the photographer and his models are producing illustrations of a dramatic kind, a system which cannot be ignored. (In America a novel has been thus illustrated both in figure and landscape.)

The last example of the photographer as illustrator, which can be given here, is where a photograph from life engraved on wood is published as a vignette illustration. [Slide from the *Graphic* of 28th of October, 1893.] It is worth observing because it has been turned into line by the wood engraver, and serves for printing purposes as a popular illustration. The original might, perhaps, have been more gracefully posed, and the effect may be to a certain extent "a fluke," but it is pretty as a vignette, and pleases the public. There are hundreds of such subjects now produced by the joint aid of the photographer and the process engraver.

Here we may observe that it is not the artist and the wood engraver who are "working hand in hand" in the production of the great majority of illustrations, as in America, but the photographer and the maker of process blocks. This is significant. Happily for us there is much that the photographer cannot do pictorially. But the photographer is, as I said, marching on and on, and the line of demarkation between original and photographic illustrations is less marked than formerly.

The photographer's daughter goes to an art school, and her influence is shown clearly in the exhibitions of the photographic societies. This influence and this movement is so strong—and vital to the artist—that I feel it cannot be emphasized too much. The photographer is ever in our midst, correcting our drawing with facts and details which no human eye can see, and no one mind can take in at once.

Of the obligations of artists to photographers a book might be written. The benefits are not, as a rule, unacknowledged; nor are the bad influences of photography always noticed. That is to say, that before the days of photography, the artist made himself acquainted with many things necessary to his art, for which he now depends upon the photographic lens; in short, he uses his powers of observation less than he did a few years ago. That the photographer leads him astray sometimes is another matter.

Whatever developments may await the art of photography, says Mr. William Small, in 1893, "it will never take good work out of a good artist's hands. In line work (the best and surest for the processes) photography can only be the servant of the artist, not the competitor—and in this direction there is much employment to be looked for. But in whatever material or style, newspaper illustrations, to hold their own, must be of the best. Let them be as slight as you please, if they be original and good. At present we are casting off—ungratefully it would seem—the experience of the lifetime of the wood engraver, and are setting in its place an art half developed, half studied, full of crudities and discords. The illustrations which succeed in books and newspapers succeed, for the most part, from sheer ability on the part of the artist; they are full of ability, but, as a rule, are bad examples for students to copy. "Time is money" with these brilliant executants; they have no time to study the value of a line, nor the requirements of the processes, and so a number of drawings are handed to the photo-engravers—which are often quite unfit for mechanical reproduction—to be produced literally, in a few hours. It is an age of vivacity, darir g originality, and reckless achievement in illustration. "Take it up, look at it, and throw it down," is the order of the day. But there is no reason, but laziness, why the work done "to look at" should not be as good as the artist can afford to make it. The manufacturer of paper hangings or printed cottons will often print only a limited quantity of one design, no matter how beautiful, and then go on to another. So much the better for the designer; but he would not keep employment if he did not do his best, no matter whether his work is to last for a day or for a year. The life of a single number of an illustrated newspaper is a week, and of an illustrated book about a year.

The young illustrators on the *Daily Graphic*—notably Mr. Reginald Cleaver—obtain the maximum of effect with the minimum of lines. Thus Caldecott worked, spending hours sometimes studying the art of leaving out. Charles Keene's example may well be followed, trying drawing after drawing, no matter how trivial the subject, until he was satisfied that it was right. "Either right or wrong," he used to say; "'right enough' will not do for me."

Another influence on modern illustrations—for good or bad—is the electric light. It enables the photographic operator to be independent of dark and foggy days, and to put a search light upon objects which otherwise could not be utilized. So far good. To the illustrator this aid is often a doubtful advantage. The late Charles Keene (with whom I have had many conversations on this subject) predicted a general deterioration in the quality of illustrations from what he called "unnatural and impossible effects," and he made one or two illustrations in *Punch* of figures seen under the then (10 or 15 years ago) novel conditions of electric street lighting, one of which I will show you on the screen. [Illustration of a gentleman who has been dining, returning home through a street lighted by electric lamps.] Charles Keene's predictions have come true. We now see the glare of the magnesium light on many a page, and the unthinking public is dazzled every week in the illustrated sheets with these "unnatural and impossible effects." Thus it has come about that what was looked upon by Charles Keene as garish, exaggerated, and untrue in effect is accepted today by the majority of people as a lively and legitmate method of illustration.

PROCESS BLOCK MAKERS.

I must mention one more influence on the young illustrator. The "process man," the teacher and inciter to achievements by this or that process, is not usually an "artist" in the true sense of the word. He knows better than any one else what lines he can reproduce, and especially what kind of drawing is best adapted for his own process. He will probably tell the young draughtsman best what materials to use, what amount of reduction his drawings will bear, and other things of a purely technical, not to say business-like character. Let me not be understood to disparage the work of photo-engravers and others engaged on these processes; on the contrary, the amount of patience, industry, activity, and anxious care bestowed upon the reproduction of drawings at the present time is astonishing and deserves our gratitude. Their work in England is a new industry of an important kind, in which art and craft are bound together. The photo-engravers are our faithful friends, and are ready to serve us well, if only the public (represented by editors and publishers) will recognize that *good work requires good pay.* The day has passed when "process work" is to be looked down upon as only fit for the cheapest, most inferior and inartistic results.

There is no doubt that the makers of process blocks are the best instructors as to the results to be obtained by certain lines and combinations of lines; but in the majority of cases they will tell the artist too much, and lead him to take too much interest in the mechanical side of the business. His best protection against this tendency, his whole armor and coat of mail, is *to be an artist first and an illustrator afterward.*

This is the sum of the matter. Perhaps some of the examples I have brought here to-night may help us, and lead to a more thorough testing of results by capable men.

THE JOULE MEMORIAL STATUE.

MANCHESTER claims the distinction of having been the home of two of our greatest men of science—Dalton and Joule—and it has shown itself worthy of the honor. A beautiful statue of Dalton has adorned the vestibule of the Town Hall for some years, and on Dec. 8, 1893, one of Joule, by Mr. A. Gilbert, was unveiled in the same place, the two philosophers standing face to face.

The unveiling of the Joule statue was performed by Lord Kelvin, in the presence of a large company. The *Manchester Guardian* gives a full report of the proceedings, and from it we extract the following remarks made by Lord Kelvin in the course of his address.

The Literary and Philosophical Society had the distinguished honor of being really the cradle of Joule's work—first as Dalton's home and afterward as Joule's lifelong scientific harbor. From very early days he kept constantly in touch with that society. Many of his most important papers were first given to the world there, and during the last years of his life he was an exceedingly regular—it might almost be said a constant—attendant at the meetings of the society. The citizens of Manchester did not require to be told what great things this society in its rather more than a century's existence had done. Their presence in such numbers on that occasion showed how much they appreciated the results of that very effective scientific institution. Now he ought to say something of the electrical, mechanical, and chemical character of Joule's work, although to examine it properly would require the space, not of one address, but of a whole course of lectures, illustrated by experiments. A great surprise that came out very early in Joule's work was burning without heat—an absolutely novel idea which Joule developed most wonderfully and most magnificently by his experiments in the generation of heat in the voltaic battery, which in those days was the only source of electricity on a large scale. Joule was the first to develop the idea, and it came to him, not as a bright flash of genius, but as the demonstrated result of years of hard, measuring, calculating work. This was the fundamental idea that pervaded all Joule's work. A few years later he expanded it in a wonderful way. About 1846, in a joint paper by himself and Scoresby, he brought out the wonderful, the truly philosophical, and at the same time startling idea that when a man or any other animal walked uphill, only a part of the heat or combustion of his food was developed, and that it was when the body was quiescent that the chemical attraction between the food and the oxygen dissolved in the blood developed its whole energy in actual animal heat. He showed, further, that the animal body was more economical for fuel than was any steam engine hitherto realized. This was a very far-reaching idea, and seemed to hold out prospects of greatly advancing the efficiency of the steam engine. That promise had not been lost. It was due to Joule, more than to any other individual, that the great improvement of surface condensation was now universal, although very rarely practiced, indeed, before 1860 or 1862. Joule, about the year 1860, in working upon a little steam engine, applied a surface condenser on an entirely new principle, and in doing so he was led to think out a mode of getting heat out of the steam to be condensed without sending a jet of water into it, as on the old plan. But he (Lord Kelvin) had not yet touched upon Joule's great fundamental discovery, the discovery which was first in every one's mouth—that of the mechanical equivalent of heat. They would understand that it was not merely by a chance piece of measurement that he stumbled on this result, which was afterward found to be of great value. It was measurement, rigorous experiment and observation, and philosophic thought all round the field of physical science that made this discovery possible. Very early indeed in his working time Joule brought out the mechanical equivalent of heat, and in a paper read at the British Association at Cork in 1843, and afterward in the *Philosophical Magazine*, he gave the number "772." Six years later a second determination gave him the same result, and twenty-five years later he made a third determination, which gave him the final and corrected result "772·56."

In the year 1824 a great theory was originated by a very young man who died only a few years later—Sadi Carnot, son of the republican minister and uncle of the present President of the French republic. It was he who made "Carnot's theory" a household word throughout the world of science; and great as was the French president, much as he had done for his country and the world, in after-times his uncle would be always remembered as one of the most distinguished characteristics attached to that great name. Carnot's theory gave an important fundamental principle regarding the development of motive power from heat. Joule's work, on the other hand, so far as the mechanical equivalent was concerned, was the generation of heat by mechanical work. It was quite the middle of the century before Carnot's work began to attract attention; but Joule was early made acquainted with it, and after fighting a little against it as differing from his own theory, he of all others took it up in the most hearty manner.

Lord Kelvin went on to say that he could never forget the British Association at Oxford in the year 1847, when in one of the sections he heard a paper read by a very unassuming young man who betrayed no consciousness in his manner that he had a great idea to unfold. He (Lord Kelvin) was greatly struck with the paper. He at first thought it could not be true, because it was different from Carnot's theory, and after the meeting he and the reader of the paper, James Joule, had a long and thoroughly discursive talk on the subject, and he obtained ideas he had never had before, although he thought he, too, suggested something worthy of Joule's consideration when he told him of Carnot's theory. He had the great pleasure and satisfaction for many years, beginning just forty years ago, of making experiments along with Joule, which led to some important results in respect to the theory of thermodynamics. This was one of the most valuable recollections of his life, and was indeed as valuable a recollection as he could conceive in the possession of any man interested in science. Joule's initial work was the very foundation of our knowledge of the steam engine and steam power. Taken along with Carnot's work, it had given the scientific foundation on which all the great improvements since the year 1850 have been worked out, not in a haphazard way, but on a careful, philosophical basis.

James Watt had anticipated to some degree in his compound engine and his expansive system the benefits now realized, but he was before his time in that respect, and had the complete foundation which Joule's mechanical equivalent and Carnot's theory had since given for the improvement of the steam engine. Might he be allowed, Lord Kelvin added, to congratulate the city of Manchester on its proceedings that day? When the cover was lifted from the statue of Joule he felt deeply touched at the sight of the face of his old friend. To his mind it was a most admirable likeness, and the ideality of the accessory of the little model held in the hand seemed to him most interesting and most striking—he thought he might say poetical. That little model was not one of Joule's first or second, but of his third and greatest apparatus for the determination of the mechanical equivalent of heat—that by which he corrected the British Association's standard ohm, which he proved to be 1·7 per cent. wrong. Regarding that standard, a diplomatic correspondence was now going on between our Foreign Office and other European governments with a view to arranging the precise terms of the definition of the ohm, which was really first worked out by Joule.

Lord Kelvin further asked to be allowed to congratulate the sculptor on the great beauty and the great success of his work, and added that Manchester now possessed statues both of the man who laid the foundation of the atomic theory in chemistry and of the man who was the originator of the whole subject of thermodynamics. If the prosperity of Manchester did not depend on chemistry and on the steam engine and thermodynamics, he did not know upon what it did depend. The energy and industry of its inhabitants were no doubt essential to its success, but they must ever remember that the material prosperity of the city was as much dependent on philosophic thought as it was upon any material appliance whatever.

Sir H. E. Roscoe, M.P., in moving a vote of thanks to Lord Kelvin for his address, mentioned that for thirty years he himself sat at the feet of Joule, whom he might therefore claim in some sense as his scientific father. He remained in constant communication with Joule up to the day of the philosopher's death. It was a great thing that in a city like Manchester, devoted as it was to industry and commerce, the citizens should be entitled to place in their Town Hall the statues of two such fellow-citizens as Dalton and Joule. Few cities in the world could boast of two greater men. In London, also, they had been doing something to show the appreciation in which not only this country but the world held Joule.

A sum of money had been raised and placed in the hands of the Royal Society for the purpose of founding a Joule studentship, and the council of the society resolved that the money should be spent in founding such a scholarship, to be awarded alternately in England and in other countries, for the purpose of encouraging young scientific men to walk in the steps of Manchester's great citizen. The first of those scholarships, of the value of £100, would be shortly awarded, and he thought he was no going too far when he said it would come to the city in which Joule lived and worked. He might mention that since the foundation of Owens College that institution could claim nine medalists of the Royal Society, and, had they lived, Prof. Jevons and Prof. Schorlemmer would have been added to the number. It would be seen, therefore, that Manchester had taken up the thread spun by Dalton and Joule, and that there was no reason to fear that their work would not be continued.

F. WATTS, of the Government Laboratory, Antigua, gives the results of the analysis of the ash of ripe St. Vincent arrowroot. The fresh root, when cleaned and scaled, yielded 1·219 per cent. of pure ash, carbon dioxide being deducted. This ash contained silica, 9·73 per cent.; phosphoric anhydride, 12·24; sulphuric anhydride, 6·39; chlorine, 6·48; oxide of iron, 0·22; alumina, 0·13; lime (CaO), 3·18; magnesia, 5·39; potash, 54·06; soda, 2·14. From these figures it is estimated that a fair crop of arrowroot would remove from the soil about 80 to 90 lb. of potash per acre. It is suggested that this should be replaced by a chemical manure, which should also contain relatively small amounts of phosphate and nitrogen.

ACCUMULATORS IN CENTRAL STATIONS.

OUR engravings are reproduced from a photograph of a storage battery installation made by the Electric Storage Battery Company at the station of the Germantown Electric Light Company, of Philadelphia.

This battery consists of one hundred and twenty elements of the chloride type, G, eleven plates each. They are installed on the three-wire system, and have a normal discharge rate of one hundred amperes on each side, and a capacity at this rate of 2,000 ampere hours.

The plates are protected by the improved asbestos insulation, and are contained in lead-lined wooden tanks set on glass insulators, and supported on strong supporting stands, painted with acid-proof paint, in four rows of two tiers each.

The special application of a battery in this instance is for the purpose of carrying the day load of the station for the commercial lighting and power circuit. The engines are shut down at daylight, and the battery carries the whole load until dusk, at which time it is thrown out of circuit, and is put into charge during the early morning hours, when the station load is light, and the cost of charging is practically nothing, as the machinery is more efficient, no extra labor being required during charge, and during discharge the working force of the station is considerably reduced, the battery requiring practically no attention.

The potential is maintained in discharge by the cutting in or out of reserve cells, six of which are used on each side.

The Germantown Electric Light Company, after over a year's experience with the chloride battery, has thoroughly demonstrated the advantages claimed for a storage battery for central station purposes.

In view of the large number of electric light stations in this country, which are to-day either running a day load at a loss or else furnishing no current at all during the daytime, the importance of demonstrating the advantages of applications of this character are clearly apparent, since a battery in such stations will not only wipe out the loss above mentioned, but show a very large profit, and enable the lighting company to furnish continuous service (Sundays included), which, of course, will be very much appreciated by their customers.

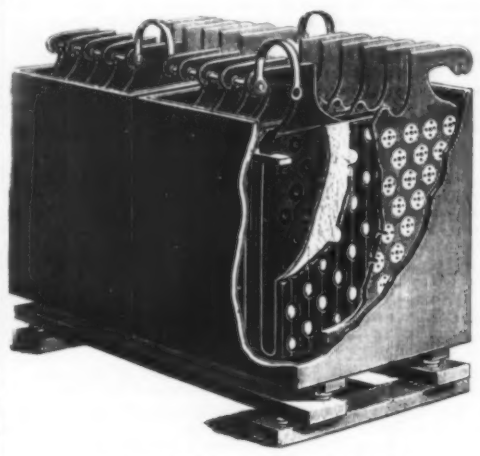
An electric light or power plant without an installation of storage batteries is like a gas works without a gas holder. Such a plant must be supplied with generating apparatus of capacity sufficient to supply the maximum demand; a demand which continues for not over one-sixth of the time—four hours out of the twenty-four. For the other eighteen hours of the day this large generating plant is operated at only a fraction of its capacity, and, therefore, at a great loss.

It will be readily understood, therefore, how much greater will be the economy of a much smaller generating plant, operated up to its utmost capacity for the whole twenty-four hours in connection with a storing plant, which during the light load will store up the surplus output of the generating plant, and which will, during periods of heavy load, give out this stored energy to assist the generating plant in supplying the increased demand. In the event of a temporary stoppage of the generators, such an auxiliary plant can carry for a time the entire load. In many electric light stations the demand during one-half of the time is so light that it does not pay for operating the plant at all during such period, and so a source of much revenue is entirely lost, which could be secured if a storing plant should be installed. As a regulator of pressure in case of fluctuations in the load the value of a storing plant is inestimable.

These fluctuations of load are particularly noticeable in electric railway plants, where the demand is constantly rising and falling, sometimes jumping from almost nothing to the maximum, and *vice versa*, in a few seconds. If for no other reason than the prevention of severe strain on the engines and generators caused by these fluctuations of demand, a storage plant will soon pay for its installation. If placed at suitable points along the line, much of the feed wire system may be done away with, and a great improvement in equality of pressure secured.

Such auxiliary plants will act automatically, and require very little attention. In case of temporary stoppage of generators or of a break in the supply circuits the value of such a constant source of supply is most apparent. An installation of this kind may be arranged to carry the whole load when few cars are running late at night and early in the morning, and for operating an "all-night" line, which otherwise would not pay expenses.

By the installing of a storage plant many natural but small sources of power may be utilized in furnishing light and power; sources which otherwise are not



THE CHLORIDE ACCUMULATOR.

available, because not large enough to supply maximum demands. The force of the tides, of small water powers from irrigating ditches, and even of the wind, come under this heading. To all of these applications the chloride accumulator is particularly adapted because of its enormous storing capacity and demonstrated durability and efficiency.

In the city of Paris, France, alone there are over 100,000 electric lamps supplied by chloride accumulators, as well as a large amount of electric power.

The chloride accumulator can be furnished of any desired capacity by The Electric Storage Battery Company, of Philadelphia.

[FROM THE NEW YORK SUN.]

RUNNING A BIG HOTEL.

"Do you think you could run a hotel?"

"Simplest thing in the world, my dear sir. All you have to do is to rent a building, hire a clerk and a cook and some other help, charge your guests more than it costs to keep them, and there you are."

This really seems such a simple undertaking that in these times of financial fancifulness it is strange, since people must live in a hotel or elsewhere, and so many cannot live elsewhere, that more people do not adopt this easy method of accumulating wealth beyond the dreams of avarice. But when one comes to investigate the running of a big hotel, it is quickly discovered that this simple formula must be relegated to the limbo of that more celebrated one for easy accumulation of wealth in stocks: buying when they are low and selling when they are high. So a *Sun* man concluded after he had passed a day in studying merely the organization necessary to the running of a big hotel, without touching upon the thousand details of finance, economics, wear and tear and kindred subjects which turn hotel men's hair gray. The *Sun* man learned facts which go to show that running a hotel requires as much planning, organization, detail and executive ability as go into the successful building, launching and sailing of a first-class man of-war, with one or two big naval battles thrown into the job.

The information was derived from Mr. Boldt, proprietor of the Waldorf, and his steward, Mr. Thomas M. Hilliard.

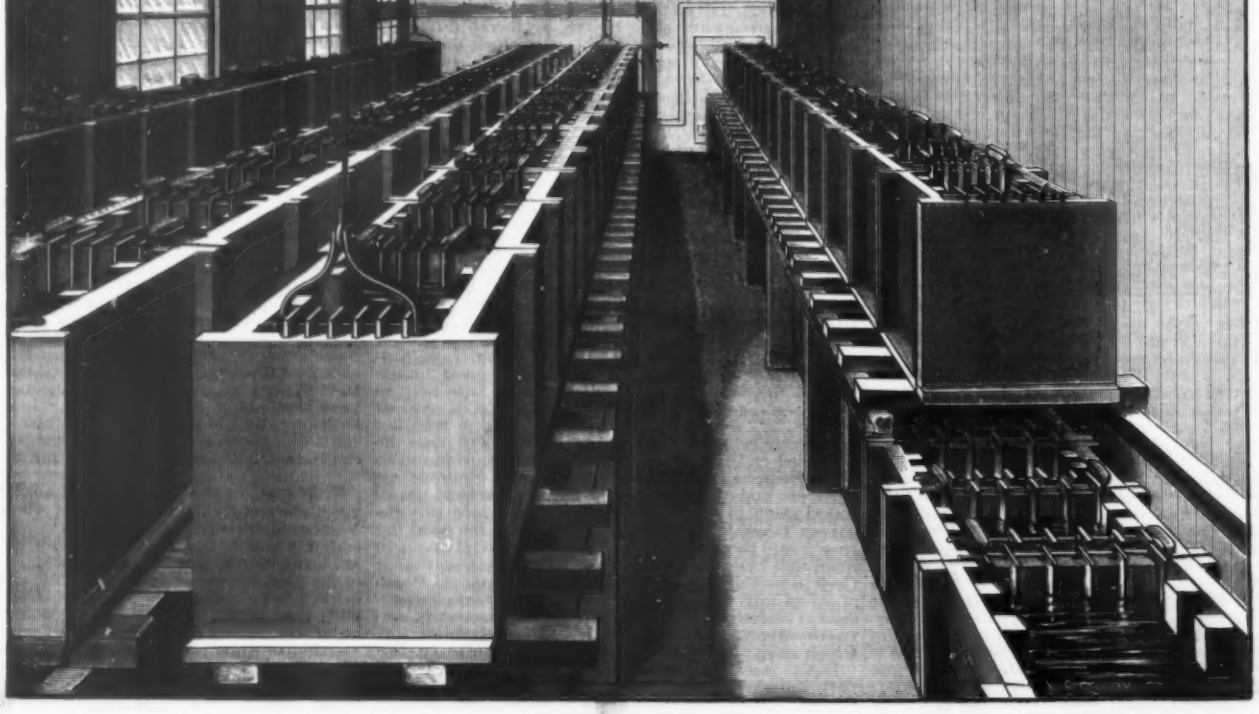
When Mr. Boldt was asked to give some facts about the organization of his staff and his army of four hundred employes, he called Mr. Hilliard to his assistance, and they together furnished the facts and figures given here.

The Waldorf organization, it should be stated first, differs somewhat from that of other large hotels. There is no officer in the organization known as the manager of the hotel. Mr. Boldt as proprietor is his own manager, and the officer next to him in the executive department is known, not as the hotel manager, but as the proprietor's manager. The other difference in the organization is in the greatly increased number of departments which come under the direct control of the steward, as will be seen further along. But these are only differences in detail; the story of the organization of the Waldorf is sufficiently like that required in any other very large hotel to prove the intricacy and variety of administration involved.

To begin, then, with the administration department. Mr. Boldt has his first assistant, who is known in the organization as his manager, and is the man in authority on the main floor when the proprietor goes out.

The main office force consists first of two room clerks. These officials must be men with absolutely no temper, but with vast capacities of judging human nature. Next come two bureau of information clerks, who were formerly known as "Front!" or key clerks, but they are more than that in the big modern New York hotel. They must not only be prepared to answer every possible question, from whether Barnum's show is still on the corner of Ann Street and Broadway to what is the most direct route to Timbuctoo, but they must be able to impart this information in a great variety of languages. There is a package clerk who conducts a carefully systematized delivery business, entering and checking every package, and requiring a receipt for every package delivered to guests. These, with two cashiers, a stenographer and three night clerks, make up the force in the main office with which guests come in personal contact. In an office upstairs there is a force of bookkeepers and clerks under the management of a comptroller where all the accounts of the hotel are kept. The comptroller has under him eight checkers, and the checks made out by each of these eight are in quadruplex, one of each going to a cashier, one to the department through which the check originated, one to the book of the comptroller, keeper of that department, and one is retained by the checker. The comptroller's force compare and verify these and keep the accounts arising through the various channels of purchase, pay roll, supplies, repairs and the multitude of details suggested as the story proceeds.

Returning to the first floor and the force which comes directly under the eye of the management, the first in evidence, to the entering guest at least, are the sixteen to twenty bell boys. In the Waldorf these bell boys are really only office messengers. They do not answer room calls, deliver cards or supply any service to a guest after they have shown him to his room. Their former varied duties have been replaced by the pneumatic tubes and the separate force of waiters on each floor. Aside from showing guests and visitors to rooms, they are kept busy by carrying the innumera-



STORAGE BATTERY INSTALLATION, GERMANTOWN ELECTRIC LIGHT COMPANY, PHILADELPHIA, PA.

ble orders which issue from the proprietor to the various departments.

Cards, telegrams, letters and messages of that sort are sent to the various floors from the office by pneumatic tube men, of whom there are two employed during the day and one at night. The head bell boy is busy at all times near the office desk standing by the side of the man on duty at the bureau of information, making a record of the name and time of all callers and the names of the persons called upon. The office floor force consists further of six door boys, two footmen, four "buttons," two telephone men, ten elevator boys, two starters, all of whom are, of course, in uniform, and three leisurely-looking ununiformed men who comprise the detective force.

The door boys open and close the entrance doors, the footmen open and close carriage doors, the "buttons" whisk the snow or dust off your coat, and at other times stand around looking ornamental, the elevator boys take you up to your floor when the starters have given them permission. The starters have a more important duty to perform, which is to watch the stairway. They act under positive instructions to permit no one to go up stairs without a written pass from the proprietor.

Mr. Boldt does not regularly designate any of his assistants to issue these passes, naming one person for that purpose each time he leaves the hotel. Even with a pass in his or her possession, a stranger cannot go up stairs unless accompanied by a hotel servant in livery. The reason for this rigid rule, and another rule which prohibits the exit of any person with a bundle from the entrance near Fifth Avenue leading into the restaurant, is obvious.

Outside the hotel doors, besides the footmen, there are two carriage starters on duty until 1 o'clock at night, two pavement men, who relieve Commissioner Andrews of the work of keeping the streets clean in front of the hotel, and a gardener who, besides keeping trim the garden strip on Fifth Avenue, attends to the plants in the garden cafe.

A very important personage not yet mentioned is the head porter; he has a first assistant and twelve baggage handlers under him; also four bootblacks and toilet room men, and four messengers. These messengers wear the hotel livery, but are for the message service of the guests outside of the hotel. That completes what may be called the office force, concerned with the work which comes immediately under the office direction.

The housekeeper's department is next most closely under the direction of the office. The head housekeeper is a woman who has two assistant housekeepers, one to look after chambermaids, one to look after the cleaners. There are thirty-six maids, eighteen cleaners, who are women, and six men window cleaners. In addition to these the housekeeper has under her direction six furniture movers, an upholsterer and his assistant, a furniture repairer and his assistant. In the housekeeper's linen room there are two seamstresses and two girls who check out clean linen in exchange for soiled. If a head waiter wants a hundred clean napkins, he can only get them in exchange for an equal number.

The laundry, which is also in the housekeeper's department, is run by a chief and one assistant, two machine men and thirty-seven laundresses. The housekeeper's force is completed by the four parlor maids who decorate the reception rooms on the lower floor.

With this enumeration is concluded the employes who are directly controlled by the proprietor and his personal staff. The proprietor manages every other department of the hotel through the man who seems to be really his chief lieutenant, the steward. The steward in turn has at least a dozen important departments under him. There is then the steward, who is personally aided by one first assistant, one bookkeeper, one receiving clerk and two timekeepers. The timekeepers have mechanical aids, because every employe in the house, excepting the men employed in the office, carries a key with which he starts a mechanical contrivance which keeps a record of his time.

The most important division controlled by the steward is that which in turn is under the direction of the chef. The chef has under him six deputy chefs; each of these being a specialist, one for roasting, one for sauces, one for vegetables, and so forth. Each of these deputy chefs has from two to three assistants, and there are also employed in the kitchen proper four men who do nothing but wash and scour the pots and pans used by the cooks, and two men who do nothing but wash the marble floor of the kitchen. Directly under the chef there are employed forty-five men—no women. In other rooms, not under the chef, are a pastry cook and two assistants, a chief baker and an assistant, a chief compounder of ices and ice cream and two assistants, and two girl helpers, whose delightful vocation it is to prepare raisins and other fruit for the pastryman. Continuing, in the general department where food is prepared for guests, there are, in another room, three oystermen, a coffee maker and two assistants, six storeroom girls, who give out lettuce, bread, butter, cheese, and so forth; two men, who supply the storeroom girls from the cold storage room; three yard men, who take the delivery of stores from dealers and distribute them to their various destinations. Then there is the big wine room in charge of a steward, assisted by four bottlers and handlers and five barkeepers.

Before going upstairs from the kitchen floor to where the food is served, it comes in proper rotation to speak of the big room known as "Help's Hall." That has a head waiter and ten women who wait on male and female employes, excluding waiters. Then there is the waiters' dining room, where four waiters are employed, and the mechanics' dining room, where two waiters are employed.

Just who waits on the waiters who wait on the waiters the *Sun* man failed to discover.

These numerous divisions and powers are necessary to supply the orders that come from five different sources, and that are grouped in the restaurant department, which is immediately under the *maitre d'hotel*, who, like the chef, is in the steward's domain.

The *maitre d'hotel* has under him the ladies' restaurant, the gentlemen's restaurant, the garden cafe, the private dining rooms and the floor waiters who serve orders to private apartments. In the ladies' restaurant there are a head waiter, three assistant head waiters, sixty waiters and twelve omnibuses. The latter are apprentice waiters, and are employed to remove dishes between courses and otherwise aid the waiters.

In the garden cafe there are two head waiters, fifteen waiters and five omnibuses. In the gentlemen's restaurant there are two head waiters, eighteen waiters and six boys. The private dining room force is merely a skeleton organization composed of a head waiter, four assistant waiters and two women, who wash by hand the fancy china used in the private rooms. This force is increased as the size and number of the private diners require. Meals are served in rooms by the floor waiters. On each floor there are a head waiter, a waiter and an omnibus always. This force, too, is increased as required. The floor waiters never go to the kitchen, their orders being supplied by the dumb waiter service.

In the ladies' restaurant, the big one on Fifth Avenue, there are six checkers and two cashiers, and in the other two smaller restaurants two checkers and two cashiers each. That completes the organization through which meals are served, except the interesting little operation which proceeds at the foot of the dumb waiter. This is on the kitchen floor. The dumb waiters are two hydraulic elevators. They can be operated only from the bottom, and two men alternate in watches at the ship-like wheel which is turned to start and stop them. When a tray has been placed on the elevator the operator touches a button which notifies the head waiter on the floor to which the tray is consigned, and then turns the wheel. As the elevator ascends an indicator marks its location, and another turn of the wheel stops it at the right floor. There was something vaguely humorous in the sight of the waiters who were serving course after course into those elevators. The waiters were dressed just as those in the restaurant, had to undergo the same inspection of their linen and finger nails; their trays had to be exhibited to a checker just the same, yet they never saw nor went near the people they were serving, and what is of more importance, the people there never "saw" them.

That ends the restaurant service, except that there is another active division required to care for the china and silver carried out to the pantries by the omnibuses. From the pantry men carry the dishes to the steam dish washers, where eight men are employed, and to the silver cleaner, where a chief and twelve assistants are employed. Dishes are washed by steam, knives cleaned by machinery and silver burnished by electricity. And, by the way, the humble bottle washers merely touch a button when they want something to revolve like lightning inside a bottle, and the ice cream man moves a lever when he needs another ton of crushed ice.

Before going into the mechanical department a few words more will conclude the list of those whose services are for the personal comfort of the guests. There are ten barbers, two ladies' hair dressers, one manicure, one chiropodist and two valets.

All the mechanical departments are under the steward's supervision. There is one chief engineer and two assistants (one for day and one for night). Each assistant chief engineer has four firemen, two oilers and one coal passer. There is one ice machine man and one tank man. No ice is used in the cold storage; the low temperature required for meats, vegetables, wine, milk and other stores is produced by cold air.

The machine shop, where all repairs to engines, pumps and elevators is done, is run by a master mechanic and two assistants. In addition the mechanical force includes one head painter and two assistants, two steam fitters, two plumbers, two carpenters, one electrician and two assistants. The plant operated by the last named furnishes 10,000 sixteen candle power incandescent lamps, and the twenty-seven pumps have a daily capacity of 3,000,000 gallons. You see what a simple thing it is to organize the force required to run a big modern hotel.

THE PIEFFORT SPINET.

THE spinet, upon which the herdsmen and shepherds of the Vosges play those pretty airs that are so much enjoyed by tourists, was invented at an epoch that cannot be precisely stated, by Dorothea, an alleged sorceress, who lived in the Valley of Ajol, near Plombieres. This musical instrument, which is exhibited at the Museum of the Conservatory, consists of an elongated box provided at one end with a shoulder piece and at the other with a neck with wooden pegs, after the manner of a violin. It is made of the wood of the cultivated or wild cherry tree, and is provided with five sonorous strings—four *sols* in unison and one *do*. It is, upon the whole, a rudimentary instrument and one that possesses several serious defects, viz.: The pins to which the strings are fixed at the shoulder excoriate the player's finger, the steel strings are difficult to mount with simple wooden pegs, and, finally, the sonorousness, in consequence of the use of an ill-adapted wood and of a metal nut, leaves much to be desired. Into this primitive spinet, Mr. P. Pieffort has introduced important improvements. The addition of a new string in the basses completes the perfect accord, *la*, *do* sharp, *mi*, of the scale of *la*. The neck is provided with six keys with racks that permit of quick and easy tuning. A piece with a special string fastener does away with the inconvenience noted above. Finally, the sonorousness is greatly developed by the use of properly selected wood. After numerous experiments, Mr. Pieffort has found that the kinds of woods should be classified in the following order, beginning in this regard with the best: Rosewood, ebony, amaranth, blue ebony, false mahogany, walnut, cherry. This classification is somewhat surprising at first sight, but it must not be forgotten that, as has been observed by Mr. Pieffort, the sound is produced in the spinet by the repercussion of the sonorous waves, and not by their vibration in the interior of the instrument, as in the violin. As a proof in support of this, Mr. Pieffort has observed that the sonorousness is diminished by more than half when the spinet is placed upon marble or metal instead of wood.

The instrument, which is not very cumbersome, being placed upon a table, is played with the left hand armed with a piece of reed serving as a fingering stick, and the right with a mediator (a piece of tortoise shell), designed to cause the alternate vibration of the strings so as to obtain at will either a continuous sound, as in the mandolin, or pizzicati, as in the guitar. Slurred notes, which add so much to the expression, are easily executed. The natural tones and semitones of the scale are obtained on the two first strings, and the alterations (sharps and flats) upon those of the center, which serve at the same time to produce a note of perfect accord. The effects of choruses are produced by the simultaneous vibration of the six strings, giving the perfect accord. The Pieffort spinet permits of playing upon a range of two octaves and a half starting from *mi*, a sixth above the grave *sol* of the violin. With the special sonorousness due to the nature of the instrument and the physical effects that it produces, it lends itself to the execution of all pieces not exceeding this range. We have heard the inventor execute the stanzas of Flegier, a pavan of Louis XIII., the Ave Maria of Gounod, and Loin du Bal, a fantaisie on *Il Trovatore*, and we can say that the instrument lends itself to every *nuance* and is very agreeable to hear. The spinet, moreover, is very easy to play, and a person ignorant of music may, in a few hours, learn to execute certain popular airs, dances especially. It is an interesting invention worthy of being presented to our readers.—*La Nature.*

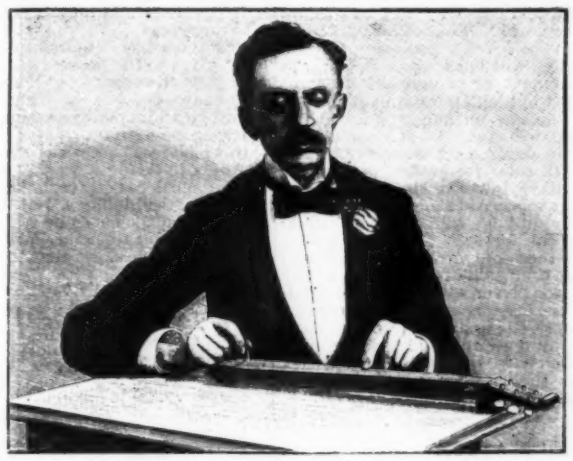


FIG. 1.—METHOD OF USING THE PIEFFORT SPINET.

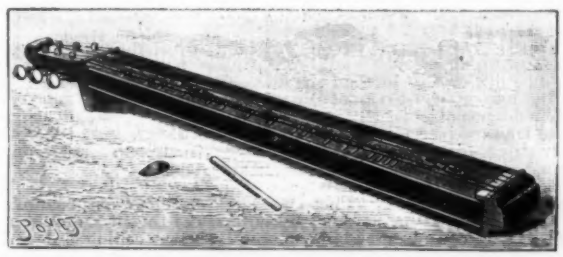


FIG. 2.—DETAILS OF THE INSTRUMENT.

IN blowing up Blossom Rock, San Francisco Bay, 43,000 pounds of explosives were used.

THE GALLOPING DONKEY—A MECHANICAL TOY.

But few novelties in the line of mechanical toys made their appearance last New Year's. The little donkey drawing a cart on a full gallop comes to us from England. It was devised by Mr. Britain, of London, the inventor of certain other toys that we have already described.

The principle of the movement of the "galloping donkey," as it is called, is simple and interesting. The two forelegs of the animal are interdependent and are jointed to the body at their upper extremity. The same is the case with the hind legs. Moreover, the axis of articulation of these latter permits the donkey to oscillate slightly between the shafts of the cart. Two wire levers, each composed of two branches oscillating in two vertical planes in the vicinity of each other, are firmly connected with the two pairs of legs, with which they make an angle of nearly ninety degrees. Between the branches of these levers there oscillates a small cranked shaft jointed to the shafts of the cart. The latter carries, concealed beneath its platform, a heavy castiron fly wheel, which, being made to revolve by means of a string, communicates its motion through friction to the two wheels of the cart. Let us suppose that the latter is set in motion in the position shown in Fig. A of our engraving, where the four feet of the animal are seen in juxtaposition and the levers held in the air by the crank. The toy being placed upon the cover of a table (a cover is necessary to prevent sliding), the hind feet will bear upon it, and, in consequence of the movement of propulsion forward, the body of the donkey will oscillate around its axis of articulation and the forelegs, no longer finding any purchase upon the table, will rise. At the same time the hind lever will tilt and cause the descent of the cranked shaft, which will then reach the position B, and this motion will have lowered the front lever, which forces the forelegs to separate to their maximum extent. The front of the animal will fall back upon the table cover, where the forelegs will meet with a slight resistance. It is, therefore, around the articulation of the forelegs that the oscillatory motion of the body will occur. The front lever will rise to the position A, and so on. As a consequence of the combination of these two motions—the oscillation of the body of the animal and the rapid approach or recession of the legs by means of the levers—the inventor has succeeded in reproducing the motion of galloping with wonderful truthfulness.—*La Nature.*

A PARIS ATTIC.

By Helen Evertson Smith.

Before landing in France most of us feel what seems to be a very reasonable degree of assurance that we who have read, and perhaps written, the French language ever since our early school days shall be able to speak it. But before we have been an hour on shore we find that we cannot even hear it understandingly, and rest in helpless bewilderment until some English-speaking porter or French-speaking friend comes to our assistance.

This much by way of explaining how I came to have some acquaintance with a Paris attic. Wishing to learn to speak the language as quickly as possible, I betook myself to a teachers' agency, established some twenty years ago, I believe, by an American. I asked for some one who would come to my lodgings to talk with me while I was dressing and eating my breakfast. Mlle. Estelle was a woman of "a certain age," short, plump, dark, bright-eyed, and vivacious, but with an almost touching sedateness of demeanor. The ridiculous sum charged for her services was two francs per hour, of which one-fourth was a commission to the agency. This seemed to me so small that I added another franc per hour, for which she immediately insisted upon giving me an extra hour whenever I had leisure to take it. After a while we compromised by arranging that she should give me from two to three hours daily, and take me about with her into places and scenes which to the average traveler remain unknown.

Mlle. Estelle, whose father and mother had been small shopkeepers, and died during the terrible siege, had inherited nothing but a good constitution, and a sturdy honesty and independence of character that always reminded me of the traits we ascribe to our Puritan ancestors. Her only sister entered a convent; but Estelle felt no "vocation," and began her life struggle entirely alone. She had received the sort of education usually to be obtained in the schools which the daughters of the poorer *bourgeoisie* attend. But from the first she appreciated its trifling character, and determined to improve upon it, supporting herself by the sale of fine embroideries while she studied hard and prepared herself for the examinations of the *Brevet Superieur*—a degree which admits the winner to teach in the highest schools. She passed this triumphantly, and then began what she regarded as the severest struggle of her life—the effort to obtain private pupils. She preferred this to accepting a position in a private school on account of the greater liberty enjoyed.

"I was not made, I, to be bound by other people's small rules of right and wrong. I believe in being good, yes, yes; but also I believe that I am just as good, just as worthy of respect, living alone in my little attic, where, when I shut my door, I may fling open the window, put out my head, and draw in the fresh air, and say: Here I am free! this is my own *chez moi*. It is poor, but no one has here a right to open my door without knocking."

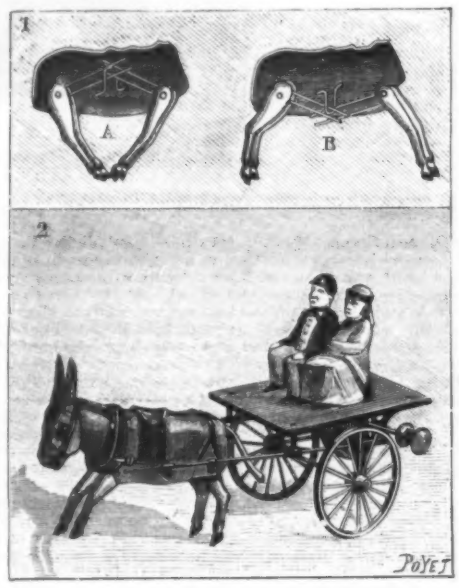
She must have had many a bitter struggle between her poverty and her purity, her native independence and the natural cravings of a strongly social nature; but she did not talk of them. A true-hearted woman, the difficulty surmounted had become but a step in her upward progress, for when I first knew her she conceived that she had attained a good measure of success. It was summer, and most of her pupils were out of town; but in the last winter she had had four music pupils, who each took two half-hour lessons a week, at one franc and a half (thirty cents). She had three boys to whom she taught Latin in class for one hour, five days in the week, at one-half franc for each pupil per hour; and two little girls to whom she gave two hours each day for one franc and a half for each pupil. And besides this, the teachers' agency had given her, for short periods, several Americans who had desired to study French. So that for six months she had averaged $11.10 a week. During the other six she was grateful for chance pupils like myself. I know that for two months she had no other.

Finding that I was curious about the way poor women live in the great city, which many deem to be the worst in the world, she took me to her own little abode. It was in a quite imposing-looking house on the unfashionable but sufficiently respectable Avenue Clichy. Before the door stood the fine equipage of some grand seigneur, who was calling upon a somewhat impoverished Bavarian nobleman who occupied the *premier*.

The *entresol* was occupied by an American family of respectability but small means. The second and third floors were tenanted respectively by the families of a French *rentier* (of moderate *rente*) and that of a violin master of high standing. The so-called *quatrieme* is actually the sixth floor if one counts the *entresol* and the ground floor where is located on one side of the entrance a little *cremerie*, or milk and butter store, and on the other the tiny bureau of the *concierge*, or janitor. This *quatrieme* is divided into small rooms—those in the center, with skylights only, being devoted to the servants of the different apartments below, while those with dormer windows are rented to members of the laboring class.

This is a really delightfully democratic arrangement, for it gives to the poorest all the advantages of fresh air, good dwellings and respectable neighborhood, which are enjoyed by those who can pay more. It would be an immense blessing to the poor in our cities if it were so with us.

In this house there was no elevator, of course; they are only to be found in the new quarters of Paris, or in the most expensive houses. Even the front stairs were long and tedious; but they were comparatively easy to climb. Those by which the atties were reached were steep and tortuous. Water was brought no higher than the *troisieme*, so that those living on the top floor



THE GALLOPING DONKEY—A MECHANICAL TOY.

1, details of the mechanism; 2, general view of the toy.

had to carry it in pails up one flight of stairs; or, the concierge would do this for them, two large pailfuls daily for two sous a week. For the proper care and cleansing of the *cabinet* for the common use of all on this top floor, a weekly sou was paid to the concierge by each tenant. As the pipes could only be flushed by water carried up for the purpose, this was a matter of importance.

Arrived at Mlle. Estelle's room the door opens upon a scene of cheer and comfort. By a pocket tape measure I find that it is only ten feet by thirteen in size, and that the ceiling is only six feet and six inches from the floor over three-fourths of this space, sloping rapidly over the other fourth down to the very floor; but it is so light that it gives one the impression of being quite a spacious apartment. The window is five and one-half feet in width, and extends from the ceiling to within one foot of the floor. It, of course, has the French sash, opening like doors, but—what seems an advantage over most—each sash is divided into upper and lower doors, so that the bottom may be closed and the top open, or *vice versa*.

One cannot see the street from this window, because the broad gutters of the house, which run below it, project too far; but there is a grand breadth of sky, and some of the fine spires and domes of the gay city are visible, besides which one may see the attic windows of one's neighbors, and all of them, without exception, are like this of Mlle. Estelle, filled with growing flowers. "They cost nothing; we get the slips from each other, and once or twice a year the concierge fills our boxes with fresh earth, for which we pay him in new plants for his own boxes, which are so far from the sun light that his plants cannot flourish long and require to be renewed."

Mademoiselle's furnishings are very comfortable, having been purchased advantageously at second-hand. One of the tables is surrounded by a curtain; when drawn aside it discloses two shelves, on which are stored a little charcoal stove, a couple of bright copper saucepans, a coffee pot and a few dishes. On each side of the window hangs a cage containing a canary.

In this attic were five other rooms the size of this. One was occupied by a mother and daughter who made artificial flowers. By steady work for long hours they could only average about eight francs a day between them, yet theirs is skilled labor.

Another room was the abode of a very young and enthusiastic artist, whose income was not mentioned, possibly because there was none.

In another were two sisters, *couturieres*, one of whom went to the houses of her customers to do the cutting and fitting, the other staying at home and sewing busily. They had great pride in the recent acquisition of an American sewing machine, which it interested me to know had cost them only $25 to import, while my own of the same make and style had cost me $65 in America. By their united labor these sisters earned a weekly average, taking good and bad weeks together, of about $14.

On the fourth room were a man, wife, and child. The man was a worker in bronze; and because he was an artisan of considerable skill, he gained eight francs a day. His wife was a "mender;" that is, she earned sometimes as much as one franc a day, but often less, by mending the clothes of such of her husband's fellow-craftsmen as had no wives or mothers to mend for them. Their little boy, only six years old, had learned to net, and could earn a few sous each week by netting toy hammocks. He did not look upon this as work, but play; and his parents very rightly thought that he might as well turn his play to some profit. The money he gained was always put in a little basket as his own, and he was allowed (not, however, without some assistance in the way of advice) to decide in what manner it should be expended. He was now striving to lay up money to buy warm clothes for winter. I wished to help by dropping a few francs into the basket, but the mother promptly resisted, saying that "if madame wished to give *le petit Francois* a present of some little thing, it would be gratefully received, but not money. No! it was not well that little boys should think that money ever came without work."

The last room of the six was tenanted by a mother and her two young sons, fourteen and sixteen years of age. The double cot of the boys and the smaller one of the mother were separated by a neat curtain. The mother was *une femme sage*, whose practice was among the wives of the poor. She sometimes received fifteen francs and her board for a "case" of which she took charge for a week; but more often three francs a day for one, two or more days. When she had not work in this line she gladly took two francs for a day of extra work in families. Her two boys were apprenticed to furniture makers, and each received a franc daily, with a luncheon of bread and wine. These were the poorest tenants in the building, as Mlle. Estelle was the richest.

All of the little rooms were kept scrupulously clean, and, therefore, there was no suggestion of squalor. Neither was there any appearance of misery, degradation, or dissipation. The young artist sometimes sang a little when he chanced to come home late at night; but there seemed no reason to accuse him of anything more than a merry heart. The dressmakers and the flower makers sometimes made common cause and invited their friends to meet in one of their rooms, while all incommodious furnishings were carried into the other, thus making space for their guests, for whom, also, spare chairs might be borrowed from the rooms of the other tenants. For all refreshment there was nothing but *eau sucree*, which is surely the most insipid drink ever offered to mortals; but to judge by the laughter and song one might imagine it to be wine of a peculiarly exhilarating effect.

Occasionally—once in a month or so—the attic tenants would combine to purchase seats at one of the cheaper theaters, buying three seats for a party of six, and then taking turns in occupying them.

In looking at the circumstances of these attic dwellers, it is easy to see that gayety is a matter of temperament and not of external conditions. It is not, however, in the least due to a happy-go-lucky turn of mind. The French are essentially provident. The "long look ahead" is a strong characteristic, and to this is due the fact that they thrive and are happy where others would starve in misery. Their calculations are good, and all things are matters of calculation.

The rents in this attic of the Avenue Clichy were, for the rooms facing south, $1.60 per month; for those with northern exposure, $1.20; the difference being made up by extra fuel in the winter. Thus, instead of being the most formidable expense in life, the rent is proportionally the most moderate. Clothes are cheaper there than here; but not so much cheaper in the grades of goods worn by the working classes as is often imagined. As the latter do not try to follow (even at a long distance) the fashion of the rich, they are saved much useless expense. Mlle. Estelle owned but three dresses—a stout linen *peignoir*, for use in her own room only; a neat but somewhat worn black alpaca, for her daily visits to her pupils, and a new one for Sunday and *fetes*. There was a little variety in the matter of ribbons and ruffles; but otherwise all the women of the attic dressed in very nearly the same way.

Most foods are more costly in Paris than here, and, if the same wasteful methods prevailed there, an income of five francs a day—which, as will be noted, is a high average—would result in semi-starvation. French methods of household economy are worthy of special attention. Almost any French man or woman can cook, and they do not deem it beneath their dignity to do so. But fuel is dear, and the useful kerosene stove, though sometimes employed, is not popular. So their thrift and good sense have planned an escape.

Every few blocks in the poorer quarters one may see a modest sign of "*Cuisine Publique*." Into one of these I went with Mlle. Estelle, and there we bought our breakfast—a bowl of a delicious and strong, hot soup, was two sous; an egg, poached or boiled, as desired, was two sous; about a foot in length of a long loaf of bread was two sous; and about half an ounce of butter was three sous; or, we could have a bowl of delicious *cafe au lait* for three sous. A bit of the beef from which the soup has been made, delicately flavored and served with mixed vegetables and a few spoonfuls of the thickened soup, was five sous. These were the prices if one chose to bring one's own dishes and carry away the food with one; or one could pay one sou more for plate and spoon or a fork and another for a napkin, and eat the modest breakfast on a long and beautifully clean counter. *Vin ordinaire* was always

to be had, and many took it, but not all; and I only once saw anything stronger taken. Other dishes can be had at proportionate rates. A really very good and nourishing meal may be had for six cents. The Parisian flower maker on her eighty cents a day can pay her rent, buy her clothes and food, and either lay aside a little for a rainy day, or help along some poorer relative, where one in this country with the same income, our rents, and our wasteful, improvident methods, would be half starved and wholly miserable.

It will be noted that these public kitchens are not charities. They are kept by persons who make a living by them. In summer they are chiefly patronized by women, who find it then more economical to buy their food cooked. In winter they are said to be filled by men, who have spent their summer elsewhere.—*The Independent.*

[Continued from SUPPLEMENT, No. 950, page 15186.]

THE METHODS OF TESTING FATS AND OILS.*

By DR. ERNEST MAILLIAU, Director of the Government Testing Laboratory at Marseilles, France.

SOLID ANIMAL FATS.

THESE are colored brown by a stream of chlorine gas.

Butter.—The analysis of this material, which has attracted so much attention during the last few years, is not so difficult as some imagine, but requires the skill of a practical and experienced analyst. The specific gravity of butter is notably lower than that of tallow and lard. It is the same with the iodin number and the freezing point of the neutral fat. The saponification and the solubility in absolute alcohol on the contrary are notably higher.

We can further confirm our results by microscopical examinations; melted butters showing under the microscope a collection of small regular spheres. Adulterated butter shows, on the contrary, abnormal figures, as well as crystals, which appear brilliant in the dark field of the polarizer.

By determining the fixed and volatile fatty acids, and the point of solubility in alcoholic toluene, a skilled analyst familiar with these processes can easily determine admixtures above 10 per cent. Below this point I do not believe any adulteration would be profitable. Natural butter contains about 11 per cent. soluble and volatile fatty acids and 87 per cent. fixed fatty acids. Besides, alcoholic toluene dissolves it almost entirely.

Tallow.—The properties of tallow are so well known that they require no description. The distinction between beef and mutton tallow is a matter of interest and presents great difficulties from the chemical standpoint, and we can observe differences only by taking the melting and solidifying points of the neutral fat and those of the fatty acids.

Lard.—Lard adulterated with cottonseed oil is easily tested with nitrate of silver. If the lard has been altered by time or by other causes, it is necessary, before using this reagent upon the fatty acids, to take the precaution of purifying the fat in the manner in which I have indicated at the beginning of this lecture. We will thus avoid the slight reduction which is produced by decomposition products.

Some authors strongly believe in the use of the iodin number, which will give good results in the case of large admixtures, as well as for quantitative analysis of such a mixture. But it is quite illusory for the detection of a small proportion of cottonseed oil, for we must consider that the iodin number of pure lard varies within considerable limits, and it would be possible to correct for the high iodin number of cottonseed oil by the addition of tallow, which will lower it appreciably. In such a mixture the action of nitrate of silver on the fatty acids enables us to discover adulteration even below 5 per cent.

Tallow is detected by observing, under the microscope, the crystallization of the fat from ethereal solution.

VARIOUS OILS.

The following oils, which frequently are used for the adulteration of agricultural fatty materials, are easily detected.

Fish Oil.—By its iodin number, its solubility in absolute alcohol, the presence of cholesterin, and finally the brown coloration by chlorin and red by caustic soda and phosphoric acid.

Resins.—By their density, their saturation, their solubility in absolute alcohol, and the deviation of the plane of polarization. Besides, it is easy to isolate them because the majority of compounds which they form with metallic salts are soluble in ether, while those of the fatty acids are insoluble.

Resin Oils.—By their property of not saponifying with caustic soda, by their insolubility in glacial acetic acid, and by the characteristic purple coloration which they give with fuming stannic chloride.

Olein Oil of Commerce.—By its solubility in alcohol and by its specific gravity.

Finally, the mineral oils, by their iodin numbers, their indifference to the action of caustic soda, and their insolubility in absolute alcohol at 15° C.

Gentlemen, we have nearly finished all we have to say in our lecture. The processes which we have just enumerated are applicable indiscriminately to fatty matters, both edible and industrial, for the determination of their purity, with an approximation sufficient for the majority of cases.

The results obtained will be more conclusive if they are compared with those from products of the same origin and known purity. Banish the thought that in this short discourse we have wished to indicate in an absolute manner those processes which must be used and those which should be rejected. We have desired only to explain the methods which have given us the best results in the thousands of analyses which we have had occasion to make on fatty materials, including 50,000 for olive oil alone.

Although most of the processes which I have just indicated were devised and perfected in our laboratory, and have been adopted by several governments, I have not, however, the presumption to feel that we have definitely finished this question. I consider, on the

* Read at a special meeting of the Chemical Section of the Franklin Institute, June, 1893.—*From the Journal.*

A GENERAL COMPARATIVE TABLE FOR THE ANALYSIS OF FATTY MATTER.

	Fatty Substance.	Density at 15° C.	Action of Nitrous Vapors.	Sulfuric Saponification. Absolute.	Sulfuric Saponification. Relative.	Indices: Bromin.	Indices: Iodin.	Indices: Acetyl.	Freezing Points of Oils.	Fusing Points of Fatty Acids	Solidification of Fatty Acids.	Saturation by Na_2O. Number of Cubic Centimeters of Normal Liquid Absorbed by Five grs. of Fatty Acid	Solubility in Absolute Alcohol. Number of Grams of Neutral Oil Dissolved by 1 cc. Grams Alcohol.	Deviation of the Plane of Polarization.	Characteristic Properties.
1	Olive,	0·915 to 0·917	Solidification. Elaidin melts at 30°	35°	84°	500 to 544	80 to 84	4·7	+ 1° to 6°	19° to 21°	18° to 19°	79·56	43	0° Sacchar.	*Action of Nitrous Vapors.*—Operate by Calliteris's process, pouring on twenty grams oil six grams HNO_3 and one gram H_2SO_4. The characteristic colorations are first with H_2SO_4 green, second with HNO_3 brownish-green, third, after boiling straw-yellow, H after cooling a hard mass, color of white butter
2	Peanut,	Unshelled, 0·915 Shelled, 0·918	Liquid Mass.	40°	92·0°	530	97	3·5	+ 4°	25°	21°	92·0	66	Variable	Arachidic acid, $C_{20}H_{40}O_2$ (fusing point 75°), is characteristic and allows the detection of 10 per cent. of this oil.
3	Sesame,	0·923	"	34°	95·0°	695	104	3·6	— 3°	26°	23°	92·0	44	"	*Maumené's Process.*—The oil is decolorized by treating the rectified fatty acid of the oil with hydrochloric acid and sugar is characteristic. The fatty acid is first collected and melted in an oven.
4	Cotton-seed (edible),	0·922	"	30°	94·0°	645	108	5·3	— 15°	35° to 37°·5	33°	88·17	59	"	*Maillart's Process.*—The black color obtained by the reduction of $AgNO_3$ in the presence of the saponified products of the rectified oil is characteristic.
5	Poppy (drying),	0·925	"	32°	89·0°	835	133	13·1	— 18°	18°	15°	89·13	45	— 6°·5	Poppy oil when used as an adulterant of olive oil, prevents the solidification of the latter in the cold.
6	Colza,	0·914 5	"	40°	110·0°	640	99	6·3	— 6°·5	17°	16°	96·49	30	Variable.	A solution of potassium hydroxid heated with unpurified colza oil thickens with lead acetate, and reddens with potassium nitroferricyanid.
7	Rape seed,	0·915	"	40°	113·5°	630	103	5·9	— 3°	15°·5	15°	97·68	15	+ 10°	Density and fusing points of the fatty acids.
8	Linseed,	0·932 5	"	34·0	93·0°	1,000	196	8·7	— 18°	21°	18°	97·08	20	Inactive.	Density, freezing point, sulfuric saponification, iodin index, freezing points and fluidity of the fatty acids.
9	Walnut,	0·926	"	30°	82·0°	737	144	7·3	— 27°	Fluid	"	98·26	44	"	Sulfuric saponification, iodin index, freezing points and fluidity of the fatty acids.
10	Cameline,	0·926	"	31°	84·0°	817	132	7·5	— 18°	"	"	97·90	28	— 3	Iodin index, freezing point and fluidity of the fatty acid.
11	Beechnut,	0·921	"	30°	85·0°	659	106	6·1	— 18°	24°	20°	98·18	15	Almost Inactive.	*Brullé's Reagent.*—Two cubic centimeters nitric acid, 01 grams dried albumen, ten cubic centimeters oil; when agitated the mixture takes a characteristic vermilion tint.
12	Mustard seed,	0·918	Soft Consistence. Rather Firm	30°	84·0°	753	98	6·9	— 8°	15°	13°	97·07	38	+ 3	Sulfuric saponification and iodin index.
13	Sweet almond,	0·917 5	Formation of Ricin-Elaidin	30°	84·0°	764	97	5·7	— 21°	23°	20°	97·63	32	Almost Inactive.	Sulfuric saponification and crystallizable acetic acid.
14	Hazelnut,	0·915	"	31°	86·0°	581	87	4·9				97·63			Density, solubility in alcohol and crystallizable acetic acid, insolub lity in
15	Castor,	0·965	"	40°	111·0°	559	84	15·3	— 18°	13°	4°	16·77	120	Soluble.	Mean = 43	petroleum ether, deviation of the plane of polarization.
16	Coprah,	0·924 5	Solidification.	13°·5	48°·5	74	13	—	+ 20° to + 40°	20°	18°	79·56	43	Soluble at 31° C. in 2 vol. alcohol.	Undetermined.
17	Cabbage palm,	0·923	"	19°	69°·7	78	11	—							
18	Palm,	0·915	"	17°	67°	325	51	—						Soluble at 4 vol. alcohol.	
19	Mowrah,	0·915	"	20°	71°	404	65·3	—							
20	Margarin from cotton-seed oil,	0·910	Soft Consistence. Solidification.	47°·5	130°	588	84·7	—							
21	Illipi,	0·915 5	"	33°·5	102°	552	84·7	—							
22	Karite,	0·917 7	"	48°·5	119°	416	67·9	—							
23	Butter,	0·900 to 0·926	Solidification.	Mean, 37°	Mean, 65°	226 to 246	26 to 35	—							
24	Suet,	{ Mutton, 0·917 Beef, 0·915	"	44°	91°	247	40	—							
25	Lard,	0·920	"	36°	95°	265	59	—							
26	Fish oil,	0·923 to 0·930	Liquid Mass. Fluid Mass. Solidification. Elaidic Acid. Liquid.	5°·0 to 10°·0	13°·0 to 17°·0	961 to 977	133 to 141	—							
27	Rosin,	1·08		—	—	718	116	—							
28	Rosin oil,	0·960 to 0·990		—	—	997	48	—							
29	Commercial oleïn (oleic acid),	900		0°	0°	443 to 518	68·5 to 83·5	—							
30	Mineral oils,	850 to 930		—	—	80 to 133	13 to 21	—							

Are colored brown by a current of chlorine.

31	Volatile fatty acids, iodin index, solidification of the neutral matter, saturation, microscopic examination.	Cod Liver, 140
32	Sulfuric saponification, solidification of the fatty acids, insolubility	Soluble, Almost Insoluble Soluble, Insoluble Cold.
33	Sulfuric saponification, iodin index.	
34	Iodin index, solubility in alcohol (milky emulsion), fusion point of cholesterin.	
35	Density, saturation, solubility in alcohol, deviation of the plane of polarization.	
36	Density, deviation of the plane of polarization, insolubility in crystallizable acetic acid.	
37	Density, nitrous vapors, solubility in alcohol.	
38	Density, iodin index, insolubility in alcohol.	

39	Compute at 0°	15°·71
40		15°·13
41		—
42		177

43	Solid 0°·5 Fusion 25°	25°·5
44		25°·5
45		25° to 35°
46		25° to 30°
47		30° to 35°
48		33° to 35°
49		25° to 31°
50		33° to 35°
51		30° to 35°
52		30° to 35°
53		25° to 35°
54		25°·5
55		24°
56		30°
57		30°
58		30°
59		30°·5

60		22°·7
61		24°
62		42°·5
63		50°·5
64		52°·5
65		24·1
66		32·5
67		18·5
68		15·5
69		18·3
70		17·7
71		14·9
72		65·4
73		3·18
74		43
75		17·71
76		15·13
77		—
78		177

79		80° to 85°
80		80° to 85°
81		80° to 85°
82		80° to 85°
83		80° to 85°

contrary, that in the vast unexplored region of the fatty series, we have only taken a few steps; but I feel at the same time that we are now in the possession of sensitive and scientific methods which permit us to detect mixtures, the determination of which has appeared impossible up to the last few years.

The mission with which I have been charged by the French and Tunisian governments in the interests of commerce and industry shows you to what extent these countries are desirous of facilitating the exportation of pure and satisfactory products. France furnishes the best growth of virgin olive oil, from Aix en Provence and Nice. Tunis also furnishes, but at a less price, olive oils of excellent quality, which we can certify without analysis, because the government imposes such heavy export and import duties upon seed and seed oils that it would be impossible to practice the smallest amount of sophistication.

Those who deal in olive oils often make the remark that pure oil is too strong and that it is improved in flavor by a mixture with seed oil. Without discussing this inexact statement, I believe that it would be preferable in every instance for the dealer to buy pure olive oil and to make his own mixtures. He would thus profit by the difference in price, which averages about 60 francs per 100 kilogrammes.

I hope you will pardon the dryness of the subject which we have just discussed, in considering how important it is for our two countries to have the same means of making analyses of American and French products. When we arrive at a complete understanding, discussions and reclamations will become impossible, and I cannot better conclude than by expressing the sincere wish that its realization will permit the two republics to bind more closely together their commercial relations.

THE PROBLEMS OF LIGHTING.

EVERY body emits luminous radiations and different colors, according as it is heated to a greater or less degree. At a slightly elevated temperature, red radiations prevail. At high temperatures, violet and ultra-violet radiations are added. The brilliancy of an incandescent body more closely approaches that of the sun in measure as the relative proportions of its various radiations more closely approach the composition of the solar spectrum. Then it appears white.

LUMINOUS OBJECTS MADE OF PHOSPHORESCENT SUBSTANCES.

It is the predominance of each simple color in the spectrum emitted by our different domestic lights that explains their respective coloration—the reddish tint of the Carcel lamp, the violet tint of the voltaic arc, the greenish tint of the kerosene lamp, etc.

Each of these illuminants has its drawbacks and its advantages, for each of the colors influences our eye diversely and specifically.

Lights rich in violet and ultra-violet rays, like those of magnesium and the voltaic arc, are certainly very harmful to the sight. It is such rays that in the solar light cause the erythema commonly called sunstroke. Moreover, such radiations, called also chemical or photographic, must hasten the destruction of the fibers of the crystalline lens, whose curves, which are variable under the action of the ciliary muscle, permit us to see objects distinctly at different distances. In fact, the crystalline lens absorbs such radiations, which are in great part invisible, and converts them into visible ones. It is phosphorescent. All those who have worked by such lights have, in the long run, experienced a painful fatigue in the muscles of the eye.

The sources very rich in greenish yellow radiations have the inconvenience of destroying to a greater degree than the others a photographic substance of the retina called erythropsine, which is not indispensable to vision, since it does not exist where the latter is most distinct, that is in the central spot; but the destruction of this substance by light corresponds to a great fatigue of the nerve, just as its regeneration in darkness coincides with the restoration of the visual power.

The visual functions are complex. We preceive light, we distinguish color, and we draw the perception of forms from differences in light. If we desire to have a perception of a luminous spot with a minimum of colored light, such spot must be bluish green. It is such radiations that are the first to appear when a metal is heated—at 417° with gold, 390° with plattnum, and 377° with iron. Bluish green excites the luminous sensitiveness. When it is desired to protect the eye against too bright a light, there is every interest, then, in adopting a bluish green glass rather than one simply smoked. The patient gains force therein for his luminous sensitiveness.

If we desire to perceive objects very distinctly, we must adopt a source of a yellow color. Every one knows that yellow is more luminous than green or red; but how much? This problem of the luminosity of the spectrum is one of those that have most exercised the sagacity of physicists and physiologists. It has as yet been but approximately solved, and with the aid of artifices. This difficulty is due to the fact that our sensitiveness behaves in a special manner for each color under identical conditions of variations in luminous intensity. For example, put a red and a blue glass in a lantern, and increase the intensity of the illuminant, and the red glass will appear to have gained more light than the blue one. The illusion will disappear if, in winking the eye, one diaphragms the retina sufficiently to reduce the images of the two glasses to an extreme smallness. The color phenomena disappears, and we no longer compare anything but grays. It is by this method, among others, that one has succeeded in seeing and measuring the different illuminating powers of colors.

Let us take a red and a blue light. We can compare them with each other in seeking the distances at which each of them will permit us to read our newspaper and may admit that they are equal when they allow us to read with the same distinctness, or, as it is said, when the visual acutenesses are equal. The variations in visual acuteness for the different portions of the spectrum have been compared with the variations in brightness. The laws are not the same. The maxima are indeed nearly in the same place in the yellow, but the brilliancy decreases much more quickly than the visual acuteness in the red. The practical consequence is that if one can employ a little more light, and desires to make characters and forms distinguishable, he will adopt a red lantern rather than a yellow one. It is doubtless to its reddish tint that the old Carcel lamp owes the persistent favor in which it is held by old studious readers.

The ideal source of light is that which would emit neither calorific radiations, which are sometimes so fatiguing in gas burners, nor obscure radiations, which are totally useless and often injurious when they favor the oxidation of the coloring matter of tapestries, etc. Take the energy of the luminous radiations on the one hand and the energy of the totality of the radiations on the other, and divide these quantities one by the other and we shall have what is called the optical rendering of a luminous source.

One of the quickest methods of measuring such rendering consists in making the radiations first traverse a stratum of sulphide of carbon, which allows them all to pass, and then an equally thick stratum of a solution of alum, which allows only the luminous radiations to pass, and in measuring the intensities in both cases with the thermo-electric pile. The oil lamp has but 3 luminous radiations out of 100, the ordinary gas burner 4, incandescent electric lamps a mean of 6, arc lamps a mean of 12, the magnesium light 15, and the Geissler tube, which is not a practical source, presents an optical rendering of about 32 per cent.

It has recently been found possible to improve the optical rendering of gas by raising to incandescence a small trellis dipped in a solution of a mixture of calcined earthy oxides (zircon and oxides of lanthanium, yttrium, thorium, corium and neodymium) and suspended by a metallic arm above a Bunsen burner. It may be asserted, however, that the optical rendering of our usual sources does not exceed 6 per cent., and that the advantage accrues to electricity.

The last word has not been uttered, it is unnecessary to say. In electric lamps, as well as in the ordinary gas burner, it is the incandescence of the carbon that gives the light. The law of incandescence of magnesium seems to be wholly different and much more favorable to high optical renderings. It is in such directions that researches should be prosecuted.

The results appear to be less brilliant still when we take into account the special conditions of production of the electric current. The rendering of a steam motor is scarcely more than 10 per cent., while that of a dynamo machine is 90 per cent. There is a loss of about 10 per cent. in the conductors, so that the final optical rendering of the energy absorbed in an electric lamp is about 1 per cent.

Nature has solved the problem in a much more brilliant manner, but not practical for our needs, in the organic substances and organized bodies called phosphorescent.

A phosphorescent body absorbs the more or less invisible ultra-violet radiations of the spectrum, and converts them into violet, green, yellow, or orange radiations without any disengagement of heat. It emits only visible radiations, many at first, and then fewer and fewer down to zero, with a rapidity that varies according to the substance.

A large number of substances are phosphorescent, but their phosphorescence often lasts less than a second, and can be observed only with special apparatus.

The substances that retain their light the longest are the alkalino-terreous sulphides: The sulphide of barium, discovered accidentally in 1602 by a shoemaker of Bologna (Vicenzo Casciorolo), and the sulphide of calcium, strontium and zinc, all prepared in a more or less paradoxical and always empirical manner.

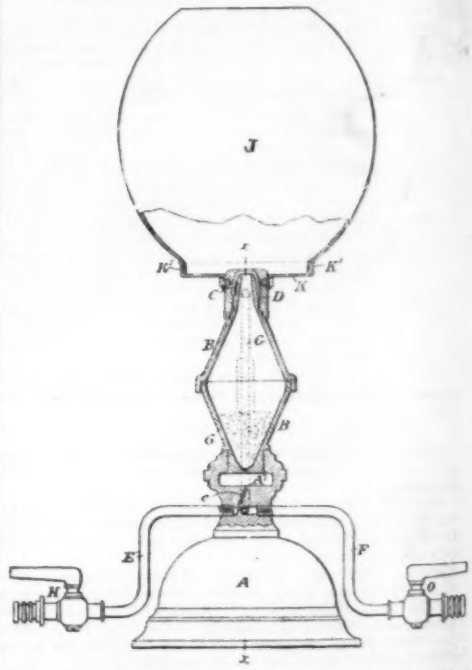
This chapter of physico-chemistry is still full of obscurities. For example, we cannot give sulphide of barium a blue or violet light, but we can give different colors to sulphide of calcium according to the nature of the lime that has served to prepare it. Its phosphorescence is yellow with limestone, green with aragonite, and violet with fibrous aragonite. These various colors seem to be due to different impurities, yellow to the presence of peroxide of manganese, blue to the presence of persulphide of potassium, and violet to traces of bismuth. In another case, in my preparation of phosphorescent sulphide of zinc, the phosphorescence seems to be due to the purity of the body.

The industries have utilized the sulphides of calcium in pocket match boxes, placards, watch dials, etc., that some years ago awakened curiosity. These sulphides are very alterable in the air, water, etc., and have to be covered with an enamel, but, as the latter scales off quite quickly, they lose their phosphorescence pretty rapidly.

The duration of the luminous emission of well prepared sulphides of calcium is quite lengthy. They still shine notably at the end of a six hours' stay in darkness. The phosphorescent sulphide of zinc is scarcely visible practically for more than two hours. This is to be regretted, since this body is remarkably unalterable in the air, water, and ammoniacal or acid vapors, etc. It lends itself wonderfully to the role of a storer-up of light. Hereafter, one might study an arrangement to permit of storing up the light of the sun upon vast surfaces, preserving it till night and concentrating it in a source by means of lenses. This would be light for nothing, at least theoretically, for the interest on the cost of the installation would render it very expensive, even if it could be intensified sufficiently to be practical. Such a source of light would evidently have a maximum optical rendering. This is also the case with the light emitted by glow-worms under the influence of the nervous system and composed almost solely of yellow and green radiations; and such is the case with the infusoria that produce the phosphorescence of the sea, and with the microbes that make the glaciers of Norway gleam.—*C. Henry, in La Nature.*

A MAGNESIUM LIGHT.

THIS invention, by W. Willis and E. J. Humphery, of London, and W. H. Smith, Surrey, Eng., relates to the production of light of great actinic power for photographic and other purposes, by burning magnesium, aluminum, or other substances in a flame of hydrogen or other inflammable gas.



The burner consists of two concentric tubes, C, D. B is the receptacle for the powdered magnesium. The inflammable gas enters through E and *e*, and passes up through the powdered magnesium, carrying some of it with it in suspension to the inner tube of the burner, C. At the orifice it meets with oxygen supplied to the outer tube, D, through F, and on being ignited the gas and magnesium powder burn. The lamp, fitted with a lens and chimney and applied as a "search light," is described.

THE GREEN COLORATION IN OYSTERS.

By AD. CHATEN and A. MUNTZ.

THIS question is at once chemical and biological. The investigation has been committed to a M. Berthelot (probably a son of the M. Berthelot of the Academy of Sciences). It is shown that the green color of oysters has no relation with the chlorophyl of plants, or with other known coloring matters, animal or vegetable. He shows also that oysters contain iron, and that the mud of the oyster beds contains iron sulphide, to which its black color is owing. Both the coloring matter and the iron are especially accumulated in the gills of the oysters, while the rest of the body is nearly colorless. The composition of the green pigment has not been determined.

THE BEAR'S PAW FERN.

AMONG the deservedly popular, as also among the many ferns which by their quaintness as much as by their beauty attract the attention of the lover of nature, this most singular plant justly holds a very prominent place.

It is known in collections under the various appellations of Aglaomorpha Meyeniana, Drynaria Meyeniana, and Drynaria philippinensis; whereas in books of purely scientific character it is found described as Polypodium Meyenianum. The sub-genus Drynaria,

THE BEAR'S PAW FERN.
(*Aglaomorpha Meyeniana.*)

to which it undoubtedly belongs, forms a small division of the most extensive of genera, Polypodium. It was originally founded by Bory, and comprises only a few, barely a dozen, known species of ferns, which are distinguished from ordinary Polypodiums by having either a separate fertile frond or its ordinary one fertile at its summit and deeply cleft at its base, like a stalkless oak leaf, brownish in color and rigid in texture. Schott gave the name of Aglaomorpha to the bear's paw fern, and to this day it is under that expressive name that it is best known.

The bear's paw fern is possessed of a quite attractive character; the rhizomes with which it is provided are of a particularly stout nature and densely clothed with narrow, crisped scales half an inch long, of a bright rusty brown color, and of a particularly soft nature. From these singular-looking organs, as thick as a man's wrist, and to which the plant owes its popular appellation, the fronds are abundantly produced. When the plant is fully developed and in good condition, these are frequently 2½ feet to 3 feet long, and 8 inches to 12 inches broad. As may be seen by the accompanying illustration, their lower portion, which is always barren, is cut nearly to the midrib into oblong entire lobes, while their upper part, which usually extends about one-third of their length, bears the fructification, which hangs out so prominently as to give the plant quite the appearance of what is commonly called a "flowering fern." This fertile portion consists of closely set narrow leaflets, each 4 inches to 6 inches long, having all the appearance of a firm midrib, with a row of small round lobes on both sides, each bearing a bright yellow spore mass, by which it is eventually entirely covered.

The bear's paw fern, which is as pretty and ornamental as it is distinct, is a native of the Philippine Islands, where, according to numerous travelers, it grows abundantly on branches of trees. This circumstance is quite sufficient to explain the difficulty which one usually experiences in growing it in a pot. It thrives apace under artificial cultivation when subjected to treatment similar to that given to Platyceriums, or stag's horn ferns. It should be planted either on a stump of partly decayed wood or on cork bark in a shallow pan or in a hanging basket, in pure fibrous peat, on which its rhizomes, which must never be buried, should at first be pegged down, free scope being allowed for their extension. As will be seen from the above description, every part of this singular plant is possessed of special interest, and when properly grown it well repays for any extra attention given to its requirements. It may be propagated from spores, but this is a long and tedious process, and it is usually increased by the division of the rhizomes, an operation which is best performed from January to April.—*The Garden.*

AN ARBOREAL JUNK.

WE are indebted to the kindness of Mr. J. H. Veitch, whose account of his travels in China, Japan, the Corea, India, have appeared during the last year, in enabling us to afford our readers a figure of a remarkable specimen of tree training. He says: "The pine figured is one of the most curious of the many interesting and strangely trained pines in the whole empire of Japan. In the Chinese garden (laid out between four and five centuries ago), attached to the Kinkakuji monastery of the Zen sect of Buddhists in Kzoto, this remarkable example of horticultural art stands alone in a court yard, the result—according to the attendant priests—of over three centuries of patient labor. Trained as a sailing junk, the main trunk forms the mast; and two branches springing from the stem at right angles, and but a few inches from the ground, form the basis from which the whole upper structure of the hull has been drawn. The hull is thirty-five feet in length, and somewhat exceeds the height of the whole tree. The remaining branches on the main trunk are bare of foliage from 12 to 18 inches from their base, the foliage being confined to the distal part of the branches, the branchlets of which have been trained in continuous winding circles, so that the leaves and young shoots now rest on thick layers of twisted, interlaced, stiffened wood, the accumulated training of many scores of years."—*The Gardeners' Chronicle.*

DRACÆNA THALIOIDES.

THIS distinct species of Dracæna, now in flower at the Royal Gardens, Kew, was discovered on the Gaboon, in West Tropical Africa, by Gustav Mann, and introduced into cultivation about thirty years ago by M. Aubry-le-Comte, who sent it to the Jardin des Plantes, Paris, where it was named D. Aubryana by Brongniart. About the same time it was sent out by Messrs. Makoy & Co., of Liege, as *D. thalioides*, under which name it was figured by Morren in *Belgique Hor-*

DRACÆNA THALIOIDES.

ticole, 1860, p. 348. Mr. Baker keeps up Morren's name in his revision of *Asparagaceæ* in vol. xiv. of the *Linnean Journal*, p. 534. There are living plants of *D. thalioides* at Kew, where it grows about a yard high, with leaves nearly a yard long, the lower half being narrow and petiole-like, the upper half a flat lanceolate blade 2½ inches wide. It flowers annually, producing an erect stout spike of whitish flowers, which are arranged in crowded fascicles and open in successive batches. The special interest attached to this plant just now lies in the fact of its having been confused with *D. Sanderiana*, which was conjectured to be a variegated variety of *D. thalioides*. A comparison of the figure herewith given with that of *D. Sanderiana* in our volume xiii. of last year, p. 442, Fig. 65, will at once prove that these two plants are widely distinct from each other. *D. thalioides* is a handsome green-leaved stove plant of easy cultivation, throwing up suckers freely and flowering annually when strong. It is, of course, a true *Dracæna* of the same set as *D. Goldieana*, and only distantly related to *D. terminalis* of gardens and its varieties, which properly belong to the genus *Cordyline*. For the opportunity of figuring the plant we are indebted to the director of the Royal Gardens.—*The Gardeners' Chronicle.*

JAPANESE PINE TREE TRAINED IN THE FORM OF A SAILING JUNK.

EARTH MOVEMENTS.*

EVERY year, every day, and possibly every hour, the physicist and observer of nature discovers something which attracts attention, causes wonder, and affords material for discussion. At one moment we are invited to see solidified air, at another to listen to telephonic messages that are being transmitted without a wire, or to pause with astonishment before a pen which is producing a fac-simile of the writing, the sketches and the erasures of a person who may be in a distant city. Not a day passes without a new creation or discovery, and novelties for our edification and instruction are brought to our notice at the meetings of societies and conventions which from time to time are held in various parts of the world. At the last meeting of the British Association, held in Nottingham, the attention of members was called to the reports of two committees summarizing a series of facts which seem destined to open a new field in the science which treats of movements in the crust of our earth. For thirteen years one of these committees has devoted its attention to the volcanic and seismic phenomena of Japan, with the result that our knowledge of these subjects has been considerably extended. Now we observe that earthquakes, which are referred to as catastrophes in the processes of mountain formation and the elevation or depression along our coast lines, are spoken of as "vulgar disturbances" which interfere with the observation of certain earth movements which are probably as common to England as they are to Japan.

Earthquake observations, although still capable of yielding much that is new, are for the present relegated to a subordinate position, while the study of a tide-like movement of the surface of our earth, which has been observed in Germany and Japan, earth

* From *Nature*.

The Great Sand Sea. Smeroe, an active volcano and the highest mountain in Java (12,300 feet above sea level). Bromo, an active volcano

THE GREAT SAND SEA OF THE TENGE MOUNTAINS, JAVA.

tremors, and a variety of other movements, which we are assured are continually happening beneath our feet, are to take their place. Only in a few countries do earthquakes occur with sufficient frequency to make them worthy of serious attention. The new movements to which we are introduced are occurring at all times and in all countries, and we are asked to picture our continents as surfaces with a configuration that is always changing. We are told that every twenty-four hours the ground on which we live is gently tilted, so that the buildings in our cities, and the tall chimneys in our manufacturing towns, are slightly inclined like stalks of corn bent over by a steady breeze. The greatest tilting takes place during the night; in the morning all return to the vertical.

Why such a movement should exist, we are not told. All that we hear is that it is too large for a terrain tide produced by lunar attraction. In Japan it appears possible that it may prove to be a concertina-like opening and shutting of the crumpled strata forming a range of mountains. To determine whether this intermittent puckering of strata, which would mean a daily increase and decrease in the height of mountains, explains the variability in the level of districts where observations have been made, is a matter for future investigation.

A problem which suggests itself in connection with this novel work will be to determine the limiting change in inclination, which we will assume means rock-bending, that culminates in sudden fracture and a jar, causing an earthquake.

Earthquake prophets up to the present appear to have lived upon the reputation of a few correct guesses, the non-occurrence of which would have been contrary to the laws of chance. As observation has shown us that a very large proportion of our earthquakes, like those which occur in the Himalayas and the Alps, and even those which occur in volcanic Japan, are produced by faulting or sudden breakages in crumpling strata, rather than by explosions at volcanic foci, it would seem that a study of the bending which leads to fracture would be a legitimate method to approach the vexed question of earthquake prediction.

Another class of movements to which our attention is called are our old acquaintances, the microseismic or tremor storms, which are now defined as long, flat waves which give to the surface of our earth a movement not unlike the swell we so often see upon an ocean. Such disturbances are particularly noticeable whenever a district is crossed by a steep barometrical gradient. It is not unlikely that these movements, which are appreciable at considerable depths, have an effect upon the escape of fire damp at our collieries, that may influence the accuracy of delicate weighing operations—as, for example, during the determination of standard weights—that they may interfere with gravitational observations and that they are a neglected source of error in certain classes of astronomical work. Our attention is next directed to the bending effect produced in certain districts by the rise and fall of the barometer, certain areas under variations in atmospheric pressure behaving as if they were the vacuum chambers of an aneroid.

Then there are the earthquakes of comparatively restful countries like our own. A large fault by which mountains are suddenly lowered and valleys compressed takes place in a distant country like Japan. Near the origin of the dislocation the shaking brings down forests from the mountain sides, and the neighboring district is devastated. As the waves spread they become less and less violent until, after radiating a few hundred miles, they are no longer appreciable to our senses. But the earthquake has not ended. As long, flat, easy undulations it continues on until it has spread over the whole surface of our globe. The waves passing under Asia and Europe reach England first, while those crossing the meridian of our antipodes and North America arrive somewhat later. At Potsdam, Wilhelmshaven and in Japan, waves of this order have often been recorded, but for the rest of the world they are thus far unrecognized. Great cities like London and New York are often rocked gently to and fro; but these world-wide movements, which may be utilized in connection with the determination of physical constants relating to the rigidity of our planet's crust, because they are so gentle, have escaped attention.

That the earth is breathing, that the tall buildings upon its surface are continually being moved to and fro, like the masts of ships upon an ocean, are at present facts which have received but little recognition. Spasmodic movements which ruin cities attract attention for the moment, but when the dead are buried and the survivors have rebuilt their homes, all is soon forgotten. It seems desirable that more should be done to advance our knowledge of the exact nature of all earth movements, by establishing seismological observatories, or at least preventing those in existence from sinking to decay. J. MILNE.

THE GREAT SAND SEA OF JAVA.

ONE of the most extraordinary valleys in the world is the Valley of Death, in Java, in which there is not a sign of vegetation, and which is often fatal to animal life. It is said that nothing can cross it alive, and that animals which wander into it drop down dead after a few minutes. The explanation of this is that carbonic acid gas is exhaled from the ground of this volcanic region, and that the gas, being heavier than air, lies in the hollows of the valley and stifles anything that tries to pass through it. The great Sand Sea of the Tenge Mountain in East Java is the crater of a huge extinct volcano, about six thousand feet above the level of the sea. It is two miles long by a mile and a quarter broad. The island of Java has, with some justice, been called "The Lid of Hell," and the title is not altogether inappropriate, as there are some thirty volcanoes in the island, and the country owes its fertility to the volcanic nature of the soil. With the exception of the wild volcanic mountains, the scenery of Java is rather disappointing, flat fields of rice properly leveled and embanked, stretching away on all sides in the low lands.—*The Graphic, London.*

[FROM NATURE.]

THE PLEIADES.

AMONG the many constellations and star clusters which attracted the attention of our early ancestors, few, indeed, were so constantly observed as that small bunch of twinkling brilliants known as the "Pleiades." From a very early date, when our forefathers were not so well acquainted with the divisions of the year as we are to-day, they needed some means by which they could tell when to sow their corn and make arrangements for other agricultural pursuits which could only be done properly in their right seasons. That they could, at any rate, get a rough approximation of such divisions of the year by means of the positions of the heavenly bodies, they soon found out, and they were thus led to observe sometimes stars, sometimes groups of stars, near the rising or setting of the sun, and even certain stars, or groups of stars, at their times of rising and setting.

That they should have chosen that group of sparkling stars, the Pleiades, to serve their purpose, does not seem at all as astonishing if one considers how easily they can be recognized in the sky, and also their important position in more remote times.

The different relative positions of the sun and the Pleiades had, no doubt, first attracted special attention to this group of stars, and we know how important a *role* they played in ancient times for calendar purposes.

Let us just consider the several positions of the Pleiades as a result of the earth's rotation and revolution round the sun. Commencing about the end of May, we find that the Pleiades are altogether invisible, as they rise and set together with the sun. As time goes on, they will appear above the horizon before the sun, the difference in the time of rising of these two objects gradually increasing. In August the Pleiades cross the meridian about the time the sun rises, and by the end of November they are visible throughout the whole night, their upper culmination taking place at the same time as the lower culmination of the sun. As November draws to a conclusion, they set earlier and

earlier, and by the end of February are visible only for a short time, disappearing altogether for a time after the middle of May.

Owing, however, to a slight movement of the axis of the earth, which makes a revolution round the pole of the ecliptic once in about 25,800 years, the point of intersection of the ecliptic with the equator is not fixed, but movable; thus we can understand that the positions of all heavenly bodies as regards their right ascensions and declinations suffer a continual but slow alteration.

This slow movement explains the reason why the Pleiades have not always been invisible at the end of the month of May, and we have only to form a simple calculation to become acquainted with the fact that about two thousand years ago this period of invisibility occurred nearly a month earlier.

A very interesting point relating to the Pleiades is the great number of different names which have been applied to them, and also the curious myths which have arisen from time to time. A most interesting account of these has recently been published by M. Richard Andree,* who has brought together a mass of matter relating to both names and myths. First, with regard to the names which were used when referring to the cluster. The general words defined them as a heap, troop, host of dancers, sieve, etc.; sometimes the simple word "many" was adopted. One finds them spoken of as herds, or hosts of animals, birds, such as hen with chickens, parrots, doves, etc. The simplest expressions really used meant "mass," and an examination of the records confirms this view.

In observing the Pleiades any one would remark how closely they are packed together. This closeness led early peoples, no doubt, to refer to them as a host or herd of animals, and hence the well known name, "the hen with her chickens."

Among many foreign names for this, we have in German, Der Glucke mit ihren Kuchlein; in Danish, aftenhone (evening hens): in French, la poussiniere; in Italian, gallinette, etc. Instead of a host of animals, we have a host of people referred to, such as, for instance, in the Solomon Islands, where they are called "togo ni samu," meaning a company of maidens. The North American Indians have also known them under the name of "dancers."

It may be thought that a natural name by which they would be known would give some idea of the number of stars in the group; this was often the case, only with different names, for a very good pair of eyes could distinguish seven stars, while generally only six were counted. The word for the Pleiades, for instance, in old high German was "thaz sibunstirri" (seven stars), while that of the South Americans, "cajupal," meant six stars. Again, in Cook's Islands the word "Tau-ono" (six) was used, while the Greeks had a special name for *each* of the seven stars.

Seeing that so much importance has been attached to the Pleiades by peoples of all countries, it is natural to find that the number of myths is by no means few; this is shown to be the case by examining the records of the ancient Greeks, the peoples from East Asia, South Sea Islands, America, etc.

To describe a few briefly, let us refer first to that which we owe to the Greeks. The Pleiades in this myth were the daughters of Atlas and Pleione, each one of which bore a separate name. The Hyades, for sorrow at the death of their sisters, or, as others say, at the destiny of their father, Atlas, killed themselves and became fixed as a constellation in the heavens. Another myth, by Pindar, describes them as the comrades of Artemis, who were turned into doves, and eventually into stars.

A myth of much interest is that of the Dyaks, and the Malays of Borneo. They say the Pleiades were six chickens followed by their mother, who remained always invisible. At one time there were seven chickens in all. One chicken paid a visit to the earth, and there received something to eat, at which the hen got so angry as to threaten to destroy both the chicken and the people on the earth. Fortunately the latter were saved by the constellation of Orion, leaving only six chickens in the brood. At that period of the year when the Pleiades are invisible, the Dyaks say that the hen broods her chickens, while at the time of visibility "the cuckoo calls."

The South Sea islanders have a myth which has some originality about it. It is to the effect that the Pleiades were originally a single star, which shone with such a clear luster as to incur the envy of the god Tane, who was in league with the stars Aldebaran and Sirius, and followed the Pleiades. Trying to save himself in a stream, the course of which Sirius had so diverted as to bring him close to Tane again, he was broken up into six bright stars by Tane himself, who hurled Aldebaran at him.

The blacks of Victoria, Australia, have a myth in which the Pleiades are considered a host of young wives who play with the young men. The myth of the Kamilaroi blacks is as follows: The Pleiades were once pretty maidens on the earth, who were followed by some young men called the Beriberi. To get away from the latter the girls climbed trees, and thence sprang into the heavens, where they were transformed into shining bodies; one maiden who remained behind was termed "gurri gurri," the shy one, and she is represented by the least bright star in the group. The Beriberi were eventually placed in the heavens, where they appear in the girtle and boomerang in the constellation of Orion.

These and many other myths, all of great interest, are mentioned by M. Andree. They inform us to a certain extent of the characters of the different nations. Much might be learned also about the origin of the various tribes of people, by seeing if the different myths can be traced back to an initial one. Those of the North American tribes, for instance, seem to have a common origin. In some instances the Pleiades were undoubtedly looked upon as a god who, besides regulating the year and looking after the fruitfulness, was the ruler of all meteorological and astronomical appearances. Hesiod refers to the rising of the Pleiades as the time for harvest, while the period about which they disappeared for some time he termed plowing time. Forty days and nights were they invisible, appearing again only as soon as the sickle was sharp. Another very well known use made of the visibility and invisibility of the Pleiades was the regulation of the traffic of ships in Greece, hence probably the Greek word for to sail, πλεειν. The rising of this group of stars was the commencement, so to speak, of the shipping season, their disappearance denoting its conclusion. At Rome, also, the same practice was in vogue.

Enough has been said to attract the reader's attention to some of the numerous interesting references about this group of stars. The nineteenth century has already seen the end of many a myth which has been solidly upheld; but as science advances, facts take the place of myths, and although much of the romance may appear to be lost, one always looks back at them with delight. Few stars, perhaps, have been so shrouded in myth as the Pleiades, and the unravelment of these myths has been the source of pleasure to many.

* See *Globus*, Bd. lxiv., No. 22, "Die Plejaden im Mythus und in ihrer Beziehung zum Jahresbeginn und Landbau."

LONGEVITY, WITH A LIST OF PERSONS KNOWN TO HAVE LIVED ONE HUNDRED YEARS OR MORE.*

By ARCHER ATKINSON, M.D., of Baltimore, Md.

To know how to attain longevity with a full amount of mental vigor and bodily health should form the *summum bonum* of mankind. To know how to prolong life and yet enjoy it is to reach the acme of all our diseases, and a knowledge of those measures which tend to prolong life healthfully should constitute the desideratum of the best of men. In spite of every effort, many die early. The poet says "the good die first;" but it is questionable whether so unpracticable a person as one who deals in rhymes and not "measures" is a fair judge for other people.

Many philosophers, or fancied such, have thought they had attained the great elixir, but their time came finally, and not later than for others, to shuffle off this mortal coil. Ponce de Leon could not live long enough to exemplify the action of the Florida waters; and it is even thought now that Florida air goes farther to prolong life than ever did its far-famed waters.

Some authorities assert that longevity may be secured by the exercise of increased human prudence; that a man who could not be expected to reach *seventy* or *eighty* years, because of delicate constitution, may actually attain the age of 100. We know that prudence contributes in all to length of days, barring the accidents of life; yet the laws of development, growth and decay are too generally recognized for thousands of years past for us to believe that we can, of our *own* volition, by *any* special system of training or of feeding, protract our ages to the full term of Methusaleh. Writers on vital statistics, like Bacon, Buffon, Flourens, Hufeland and others, have given valuable information, as far as they could, on this subject; yet their writings are more like fairy tales than statistics really. Lord Bacon thought the ancients possessed some secret (art) of prolonging life and that this secret had been lost, but that diligent research might restore it; but in this search he failed hugely. In the *Encyclopædia Britannica* some one suggested that the people, before the deluge, regained their vital powers by now and then partaking again of the "Tree of Life," just as the gods fed on ambrosia and slaked their thirst on nectar.

Buffon, the naturalist, thought that in early days the earth was less solid and compact than now, and that the laws of gravitation operated more feebly. When we hear of men in the olden days living to be of such fabulous ages, we do not exactly know how long was the year in those days.

There is all the difference in men. Some are born lazy, and, like reptiles, continue so all their lives. Others are ever on the move or on the watch, either to do good to themselves or to humanity. Some do not know when they get old or feel the encroachments of age and decay. Delfrench, at 120 years of age, wanted to re-enlist as a soldier; while an old soldier in the district of Polosk, in Russia, was 160 years old, and had seen seven successive sovereigns.

Man grows about the slowest of all animals. Many cold-blooded animals have an almost indefinite period of life. They go slowly, and they live long, as the tortoise; and yet the eagle is a long-lived and active bird. The carp-fishes in the lake at Fontainebleau, in France, many of them still show, on rising to the surface, the rings which Diana of Poitiers, in the days of Francis the First, had caused to be placed in their noses. Some of these fishes are blind and almost blacked, yet they still live on, as large as sturgeons, some of them. Halier says there are individuals who have lived to 120, 140 and 160 years, to say nothing of Thomas Parr, of England.

Man is like a forced plant in these modern days—like a sprout in the hot-house. Precocious education ends in early death or in worse things. The temperature of the biceps muscle at rest is two degrees less than after sawing wood for a few moments, and yet the arm is the better for the exercise. Without exercise, the appetite fails and growth becomes retarded, where we fail to eat and to assimilate the proper amount and kinds of food.

Attempts have been made to build up theories for the prolongation of life. Some have thought that a diet suitable to each period of growth would accomplish the end and prolong life to the full one hundred years. Flourens stated the length of life to be a multiple (*fixe*) of the period of growth, which usually ends when the bones become united to their epiphyses. Then judging twenty years for that growth and union, he argued that one hundred years should be the normal period of life. Experience has shown that neither labor nor rest will do much more toward prolonging life than if no special care is taken. Yet it has been observed that an active, indeed a fatiguing life, during the first half of a man's existence, conduces to old age, but that the latter half of his life should be uniform and peaceful.

Cornaro, an Italian nobleman and a centenarian himself, declared that a man at fifty years of age had attained but half his life. Even Japanese girls attain their majority at fifty years.

Good living is considered in England so conducive to longevity that even the "Roast Beef of Old England" has become one of her naval airs. It is the "merry heart that makes glad" that promotes long life, and which keeps its owner "with loins ever girded, alert for an expected call," and not like the cynic referred to by Beecher as the "human owl, vigilant in darkness and blind to the light." How grand if we could all live, like Mrs. Dalton, to the age of 102 years, and who smoked until she was 100 years old, and then stopped it for fear the habit might shorten her life; better far than being like the Laplanders, who all look alike and appear like Minerva in being all of the same age, or like Cartaphilus, who never gets beyond one hundred years, always returning to the original thirty years.

The physician should know as well how to let live as to live himself—"to let life in as well as to keep death out;" and to know how to live and to apply that knowledge has been man's aim since creation's dawn.

Seth lived 912 years.
Enos lived 905 years.
Cainan lived 910 years.
Judith lived 105 years.

For some years I have been compiling from reliable sources the following list of persons who are known to have lived a hundred years or more:

Monsieur Chevreul, France, aged 103 years, living 1888.
Mrs. Stillwaggon, Long Island, aged 103 years, living 1888.
Miss Rebecca Russell, Brighton, Md., aged 100 years, living 1888.
Zephoniah Bunce, Port Huron, Mich., aged 100 years, living 1888.
James Cameron, Albany, N.Y., aged 105 years, died 1883.
Sloan, Catharine, Roanoke, Va., aged 100 years, living 1888.
Perkins, George S., Norwich, Conn., aged 100 years, died 1888
Ryder, Jane, Orrington, Me., aged 103 years, living 1887.
Muckleweid, Mrs., Page County, Va., aged 110 years, died 1884.
Fielder, John, Laurens County, S. C., aged 107 years, living 1888.
Wheeler, Agnes, Carthage, Tenn., aged 106 years, died 1888.
Heal, Chesley, Learmount, Me., aged 100 years, died 1888.
Gordon, Jeffery, San Diego, Cal., aged 107 years, living 1888.
Muncey, Jacob, Elkton, Va., aged 116 years, died 1888.
Hickey, Ann, Great Barrington, Mass., aged 105 years, died 1893.
Hadden, Mrs., Dinwiddie County, Va., aged 102 years, died 1874
Stravarides, George, Smyrna, Asia, aged 132 years, died 1876.
Casterwelder, Mrs., Frederick County, Md., aged 114 years, died 1877.
Smith, Osterdock, Mrs., Frederick County, Md., aged 103 years, living 1875.
McKay, Margaret, Fort Royal, Va., aged 102 years, died 1888.
Steele, Alletus, Passaic, N. J., aged 105 years, living 1875.
Valentine, Nancy, Cumberland, Md., aged 100 years, living 1875.
Chapin, E. B., Dr., Charlotte, Mich., aged 105 years, living 1875.
Authors, Hester, ——, aged 115 years, died 1875.
Najoleki, Mrs., Kamoinken, aged 103 years, died 1575.
Cornaro, an Italian, Italy, aged 100 years, died 1566.
Cugna de Numas, Bengal, aged 370 years, died 1556.
Mann, ——, Haritz, Bavaria, aged 105 years, died 1875.
Bœhm, Father, New Jersey, aged 101 years, living 1875.
Locke, Nelly, Millwood, Md., aged 111 years, died 1875.
Bowie, John, —— ——, aged 102 years, died ——
Johnson, Nath., Frederick, Md., aged 104 years, died 1875.
Wilson, Sol., Jackson Co., Ind., aged 104 years, living 1875.
Carter, Elijah, Balt., aged 100 years, died 1875.
Long, Moses, Kentucky, aged 111 years, died 1875.
Allen, grandson of Ethan Allen, aged 101 years, died 1875.
Landsperger, Catherine, Balt., aged 106 years, died 1875.
Duvall, Alice, Mrs., Pr. Geo. Co., Md., aged 100 years, died 1876.
Bogart, Albert, Paterson, N. J., aged 103 years, died 1882.
Hansborough, Mrs., Culpeper, Va., aged 107, died 1859.
Jones, Henry, Balt., aged 112, living 1882.
Files, Sarah, Clifton, Ohio, aged 100 years, died 1875.
Royal, Peter, Lee Co., Va., aged 105 years, living 1875.
Lether, ——, Balt., aged 105 years, living 1875.
Baynor, Sally, Balt., aged 101 years, living 1875.
Potter, Mrs., Balt. Co., Md., aged 101 years, died 1875.
Falkner, Ro., Warrenton, N. C, aged 105 years, living 1879.
Williams, Jennie, York, Pa., aged 105 years, died 1875.
Ann of Earls, Barton, Eng., aged 100 years, living 1876.
McIlleor, Griffintown, aged 105 years, living 1879.
Holgate, Dr., Salem, Mass., aged 100 years, died 1829.
Mafelsky, Kammonken, Prussia, aged 103, died 1877.
Laherbush, Capt., London, aged 100 years, living 1874.
McKim, Wm., Rich'd, Va., aged 130 years, died 1818.
Kentz, Elizabeth, York, Pa., aged 103 years, died 1766.
Somet de la John, York, Pa., aged 130 years, died 1766.
Tarrance, Dick, Clinton, N. C., aged 100 years, living 1877.
Smith, Jas., Princess Anne, Md., aged 109 years, died 1880.
Brooke, Wonder, Pr. Ed. Co., Va., aged 126 years, died 1819.
Johnson, Isabel, Toronto, Can., aged 110 years, died 1880.
Spencer, Eleanor, Accomack Co, Va., aged 121 yrs., died 1771.
Adams, Frances, Balt., aged 104 years, died 1877.
Lange, Chas., Campbell Co., Va., aged 121 years, died 1821.
Dougherty, Mary, Phœnixville, Pa., aged — yrs., living 1880.
Roberts, Charles, Bullspen, aged 116 years, died 1779.
Welsh, Benj., Balt., aged 108 years, living 1877.
Crull, Phil., Fairfax Co., Va., aged — ——, died 1813.
Holloway, Bonnie, Fauquier Co., Va., aged 115 years, died 1882.
Skelton, Mrs. Emma W., Ashburton, Mass., aged 103 years, died 1881.
Rudisell, Polly, Miss, York, Pa., aged 99 years, died 1882.
Rudisell, Mrs., York, Pa., aged 111 years, —— ——.
Webster, Dora, col'd, Phila., aged 105 years, died 1881.

* From the *Virginia Medical Monthly*.

Gassoway, Margt., Phila., aged 106 years, died 1881.
Brouch, Cath., Mrs., Boston, aged 111 years, died 1882.
Wingfield, H. Sally, Mrs., Chicago, aged 111 years, died 1882.
Speade, Ann, New York, aged 105 years, died 1882.
Frazier, Sallie, col'd, Harrisburg, Pa., aged 102 years, died 1882.
McElroy, Mary, Greensburg, Ind., aged 106 years, died 1882.
Dempsey, Margt., Ellenville, N. Y., aged 111 years, died 1880.
Thomas, Charlotte, col'd, Carroll Co., Md., aged 100 years, died 1882.
Cusarp, Thos., Iowa, aged 106 years, died 1882.
Duvall, Sarah, Iowa, aged 101 years, died 1882.
Weston, E. T., Mrs., New Hampshire, aged 104 years, died 1882.
Brown, Jennie, Washington, aged 110 years, died 1880.
Thompson, Sarah, Mrs., New York, aged 101 years, died 1879.
Bogart, Alb. C., Paterson, N. J., aged 100 years, living 1881.
Brownfield, Benj., Monroe, Pa., aged 101 years, living 1880.
Graham, Lydia, Mrs., Pt. Lyon, N. Y., aged 104 years, died 1880.
Payne, Luray G., Stafford Co., Va., aged 101 years, died 1881.
Hamilton, Mary, Harford Co., Md., aged 102 years, died 1879.
Glover, Prudence, Cincinnati, O., aged 100 yrs, living 1880.
Koehler, Mary, Balt., aged 110 years, died 1878.
Jackson, John, Vienna, N. Y., aged —, died 1878.
German, Edith, Phila., aged 115 years, died 1880.
Frank, negro man, Woodstock, Va., aged 114 years, died 1820.
Taylor, Wm., Pittsylvania Co., Va., aged 114 years, died 1794.
Ingraham, Rev. Dr., Scotland, aged 103 years, died 1879.
Rice, Maria, Mrs., Lehigh Co., Pa., aged 107 yrs , died 1819.
Berkely, Alex., Charlotte Co., Va., aged 114 yrs., died 1825.
Neanone, Mary, Mrs., N. Y. city, aged 106 years, died 1879.
Walker, Quag, Jefferson, Texas, aged 103 years, died 1875.
Valentine, Nancy, Allegany Co., Md., aged 114 years, died 1878.
Manning, Catharine, Balt , Mich., aged 106 yrs., died 1882.
Carmichael, Priscilla, Surry Co., Va., aged 103 years, died 1818.
Berkeley, Mrs. A., Charlotte C. H., Va., aged 111 years, died 1826.
Delpench, — — —, 120 years, ——
Carter, Sarah, Petersburg, Va., aged 112 years, died 1825.
Farrin, Fanny, Kenonsville, N. C., aged 110 yrs., died 1877.
Worton, Mrs. Charlotte, Va., aged 111 years, died 1773.
Negro, Richmond, Va., 130 years, died 1818.
Harrison, Mrs., Brunswick, Va., aged 110 years, died 1885.
Holyoke, E. Aug., Dr., Salem, Mass., aged 101 years, living 1881.
Johnson, Washington, D. C., aged 115 years, died 1823.
Gelbert, Augusta Co., Va., aged 112 years, died 1844.
Coffer, John, Norfolk, Va., aged 120 years, died 1836.
A man in Haretz, Bohemia, aged 105 years, died 1675.
Brooks, Utica, N. Y., aged 102 years, died 1876.
Massey, Cath., Phila., aged 100 years, died 1879.
Johnson, Silby, Balt., aged 102 years, died 1881.
Routte, Joseph, Oxford, Eng., aged 100 years, ——
Atkins, Sylvanus, Valatie, N. Y., aged 104 yrs., living 1877.
Negro woman, Long Island, aged 115 years, died 1875.
Graves, Jemima, Springfield, Mass., aged 100 years, living 1875.
Smith, Lady, London, aged 104 years, living 1876.
Johnson, Maria S., Balt., aged 100 years, died 1875.
Woman, East Balt., Md., aged 102 years, died 1877.
Gittings, Mrs., Rockville, Md., aged 102 years, died 1873.
Mead, Ira, Mrs., Greenwich, Ct , aged 106 years, living 1876.
De Pouson, d'Allegre, Marquis, Paris, aged 102 years, living 1875.
Fowler, Mrs., Balt. Co., Md., aged 112 years, died 1876.
Van Ranselear, Mrs., Fairpoint, N. Y., aged 100 years, died 1875.
Blackwell, John H., Troy, N. Y., aged 108 years, died 1875.
Young, Charles, Scots Guards, aged 108 years, died 1875.
Boddy, Charles, Wrightsville, Pa., aged 115 years, died 1876.
Shaw, Betsy, Warren, N. H., aged 101 years, died 1875.
Levering, Abigail, Oxford, N. C., aged 100 years, living 1875.
Kellerhouse, Ann, Kinderhook, N. Y., aged 106 years, died 1875.
Hughes, Mary Ann, Dorchester Co., Md., aged 107 yrs., died 1876.
Labor, Monroe, Penn., aged 112 years, died 1875.
Marchand, Adela, Paris, France aged 108 years, died 1876.
Darke, Horner, Washington, D. C., aged 112 years, died 1879.
Leopold, Elizabeth, Mrs., Graniteville, S. C., aged 107 years, died 1878.
Hinmond, North Barry, Ct., aged 100 years, died 1875
Lansperger, Catherine, Balt., aged 106 years, died 1878.
Jenkins, Harry, London, aged 170 years, died ——
Evans, Mrs., Augusta Co., Va., aged 102 years, died 1875.
Goodall, Mary, Mrs., Pequonan Bridge, Ct., aged 103 years, died 1880.
Patrick, Lucy, London, Canada, aged 100 years, died 1878.
Dempsy, Ann, Smyrna, Del., aged 100 years, died 1867.
Woman, London, aged 120 years, died 1875.
Aicha Ben Saherns, Algeria, Africa, aged 112 years, died 1879.
McClelleney, Portsmouth, Va., aged 115 years, died 1876.
McLaughlin, James, Harford Co., Md., aged 100 years, died 1875.
Woman, Hungary, aged 117 years, died 1855.
Wright, Betty, Lynchburg, Va., aged 105 years, died 1879.
Wilkerson, Wm., Balt., aged 102 years, died 1875.
Jerome, Polly, New London, Ct., aged 102 years, —— 1880.
Denney, Ann, Mrs., Smyrna, Del., aged 103 yrs., died 1877.
Bullock, John, Bristol, R. I., aged 105 years, died 1876.
Foyenbacker, Betty, Barton, Md., aged 104 yrs., died 1880.
McDewett, Margaret, New York, aged 105 years, died 1875.
Coffee, Mary, New York, aged 105 years, died 1875.
Man, Horitz, Bohemia, aged 105 years, —— 1875.
Bandeau, Michael, St. Louis, aged 106 years, died 1876.
Rutter, Elizabeth, Balt., aged 100 years, —— 1875.
Morris, Susan, Phila., aged 118 years, died 1880.
Armstrong, Mechanicsburg, Pa., aged 101 years, died 1879.
Woman, Hungary, aged 112 years, died 1872.
Woman, London, aged 102 years, died 1875.
Kennon, Lucy, Kentucky, aged 123 years, living 1876.
Michael, Edward, York, Pa., aged 108 years, died 1876.
Haling, Phœbe, Point Pawnee, Vt., aged 105 yrs., died 1878.
Woman, Omaha, aged 100 years, living 1877.
Wallback, Mrs., New York, aged 100 years, died 1878.
Bratt, Nicholas, Hart's Falls, Mass., aged 100 years, —— 1879.
Woman, Almshouse, N. Y., aged 103 years, died 1876.
Ingram, Dr., Wrist, Scotland, aged 100 years, died 1876.
McGavey, Bayou, Louisville, Ky., aged 105, —— 1879.
Wood, Mrs., Pr. Geo. Co., Md., aged 105 years, died 1850.
McGarity, Kate, Mrs., Balt., aged 100 years, died 1878.
Wood, Mrs., Pr. Geo. Co., Md., aged 100 years, died 1846.
Cornise, Henry, Dorchester Co., Md., aged 107 years, living 1879.
Schnebly, Mary W., Mrs., Hagerstown, aged 103 years, died 1876.
Woodruff, Roxana, Vineland, N. J., aged 100 yrs., died 1876.
Gorman, Patrick, Ottawa Co., Mich., aged 110 years, died 1879.
Bardsley, Simon, Balt., aged 110 years, died 1876.
Darr, Phillip, Warren Co., Va., aged 105 years, died 1876.
Hawley, Hamit, Boston, aged 103 years, living 1875.
West, Benj., Balt., aged 109 years, died 1879.
Labor, Monroe Co., Pa., aged 112 years, died 1872.
Bass, Thomas, Phila., aged 107 years, died ——
Mahoney, Margaret, Boston, aged 109 years, died 1879.
Maiden, Ladya, Stonaway, aged 115 years, living 1880.
Truly, Dolly, Balt., aged 105 years, living 1880.
Hall, Margaret, Mrs., Baptist Home, Phila., aged 104 years, living.
Brink, Maria, Mrs., Highwood, N. Y., aged 100 years, living 1876.
Jones, Alice, Miss, Talbot Co., Md., aged 100 years, died 1876.
Gilbert, Jane, Mrs., Balt., aged 102 years, living 1879.
Patsy, Aunt, Washington, D. C., aged 115 years, died 1876.
Crier, Lilly, Balt., aged 108 years, died 1879.
Smith, Jno., Phila., aged 104 years, died 1876.
Armstrong, Robt., Newburg, Ont., aged 100 yrs., died 1879.
Groom, Esther, Princeton, Ky., aged 120 years, living 1876.
McGregor, Milby, Berlin, Md., aged 108 years, died 1877.
Carter, Esther, Fauquier Co., Va., aged 140 years, died 1858.
Conrad, Richard, Montgomery Co., Pa., aged 109 years, died 1877.
Whalley, Edwin, Eastern Shore of Md., aged 103 years, died 1718.
Montpensier, Jude, Balt., aged 100 years, living 1879.
Sprinklar, Sarah, Balt., aged 103 years, died 1880.
Harry, colored, Balt. Co., 11th District, aged 110 years, died 1877.
Farny, Fanny, Mrs., North Hampstead, Pa., aged 103 years, living 1877.
Gary, Margaret, Mrs., Coborrus Co., N. C., aged 116 years, died 1877.
Pratt, Trueman, col'd, Balt., aged 102 years, died 1877.
Carrigan, Patrick, New York, aged 104 years, died 1878.
Padestaoneta, Augla, Mrs., Cin., O., aged 109 yrs., died 1878.
Turner, Larkin, Georgia, aged 110 years, died 1878.
Halligan, Patrick, Balt., aged 101 years, died 1878.
Joynes, Amy, col'd, Accomac Co., Va., aged 105 years, living 1878.
Kretzen, Eliz., Mrs., Balt., aged 108 years, died 1882.
Doran, Barney, New York, aged 106 years, living 1879.
Olixir, Lydia, Balt., aged 109 years, died 1879.
Edison's grandfather lived 103 years.
Edison's grandmother lived 107 years.
Shelton, Patsy, Christiansburg, Va., aged 115 yrs., died 1880.
Steadwell, Ellen, col'd, New York, aged 104 years, died 1880.
Hamilton, Ed., Harford Co., Md., aged 104 years, died 1880.
Hamilton, Jane, Harford Co., Md., aged 103 years, died 1879.
Stevenson, Cath. K. M., N. Y., aged 101 years, died 1882.
Newton, Eliza., col'd, Balt., aged 100 years, died 1880.
Brady, Lew, col'd, Westchester, N. Y., aged 107 yrs., living 1880.
Cunningham, Miss, Glasgow, aged 102 years, living 1880.
Dorsett, Dan. N., Rev., Elgin, Ill., aged 100 years, died 1879.
Kelly, Mary, Mrs., Richmond Co., O., aged 100 years, died 1881.
Thompson, Sarah, Washington, aged 102 years, died 1881.
Brady, Lewis, New York, aged 108 years, died 1881.
Mahone, Rachel, Phila., aged 100 years, died 1881.
Cornaro, Italy, aged 100 years, died 1566.
Campas, Marcellina, Havana, aged 114 years, died 1888.
Reiley, John, Frederick Co., Va., aged 107 yrs., died 1884.
Eggleston, Thos., Lincoln Co., W. Va., aged 112 years, died 1888.
Hinton, Henrietta, Balt., aged 100 years, living 1888.
Washington, Maria Catharine, Carlisle, Pa., aged 100 years, died 1888.
Marshall, Margaret, Allegheny Co., Pa., aged 101 yrs., died 1888.
Dr. Jackemoviez, Russia, aged 106 years, died 1888.
Washington, Rosetta, Louisville, Ky., aged 121 years, living 1888.
Clendennin, Chas., Allegheny Co., Pa., aged 100 yrs., living 1888.
Mahala, Thos., Sharpsburg, Md., aged 100 years, died 1888.
Besser, Sarah W., Balt., Md., aged 100 years, died 1889.
Reily, Mrs., Balt., Md., aged 104 years, died 1889.
Reily, Bernard, Balt., Md., aged 109 years, died 1889.
Dutton, Margaret, Mrs., Shelbyville, Ind., aged 102 years, ——

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

Page

I. ASTRONOMY.—The Pleiades.—Notes on the Pleiades and their movements ....
II. BIOLOGY.—Longevity, with a List of Persons Known to Have Lived One Hundred Years or More.—By ARCHER ATKINSON.—A curious investigation, with an exhaustive list of known centenarians ....
The Green Coloration in Oysters.—By AD. CRATEN and A. MUNTZ.—A mystery of the oyster discussed ....
III. BIOGRAPHY.—The Joule Memorial Statue.—Erection of a statue to the great electrician in Manchester.—Proceedings incident thereto ....
IV. CHEMISTRY.—Notes on the Analysis of the Ash of Arrowroot.—The Methods of Testing Fats and Oils.—By Dr. ERNEST MAILLIAU.—Conclusion of this exhaustive paper, with elaborate table ....
V. CIVIL ENGINEERING.—The Aerial Railway at Gibraltar.—A curiosity in transportation.—3 illustrations ....
Tunnels Near New York City.—An account of the various tunnels in the neighborhood of the metropolis ....
VI. CYCLING.—The Cycle Exhibition at Paris.—Curiosities in the cycles exhibited at the Paris show.—4 illustrations ....
VII. ELECTRICITY.—Accumulators in Central Stations.—A large chloride battery recently installed in Germantown.—2 illustrations ....
VIII. FINE ARTS.—The Art of Book and Newspaper Illustration.—By HENRY BLACKBURN.—A contribution of this paper on the subject of the printer's and engraver's art.—Different processes described ....
IX. GEOGRAPHY.—The Great Sand Sea of Java.—The Valley of Death and the Great Sand Sea.—1 illustration ....
X. HORTICULTURE.—An Arboreal Junk.—A curiosity, in Chinese gardening.—1 illustration ....
Dracæna Thalioides.—A distinct species of Dracæna recently in flower in the Kew Gardens.—1 illustration ....
The Bear's Paw Fern.—A very pretty and useful fern.—1 illustration ....
XI. INTERIOR DECORATION.—The Problems of Lighting.—How to light apartments.—The use of phosphorescent substances for the purpose.—1 illustration ....
XII. METALLURGY.—The Era of Nickel Steel.—By W. L. AUSTIN.—The great metal for ordnance and armor plates ....
XIII. MISCELLANEOUS.—Running a Big Hotel.—A graphic description of the trade of the Boniface ....
The Galloping Donkey.—A Mechanical Toy.—A pretty toy recently introduced in France.—2 illustrations ....
The Piefort Spinet.—An improvement on a very pretty and characteristic instrument of the Vosges.—2 illustrations ....
XIV. NAVAL ENGINEERING.—The Japanese Cruiser Yoshino.—The new addition to the Japanese navy from the Elswick Yards.—1 illustration ....
XV. PHOTOGRAPHY.—A Magnesium Light.—A light burning magnesium powder, applicable as a search light or for photographic purposes.—1 illustration ....
XVI. SEISMOLOGY.—Earth Movements.—The different movements to which the earth is subjected ....
XVII. SOCIAL ECONOMICS.—A Paris Attic.—By HELEN EVERTSON SMITH.—How the French live, with details of their expenses and accommodations ....
XVIII. TECHNOLOGY.—Antichlors.—Notes on an important step in the bleaching process ....
Dahl's Sulphate Cellulose Process.—Details of formula of fiber making process ....
Sulphite Digester Linings.—The manufacture of apparatus for fiber process ....

CATALOGUES.

A Catalogue of Valuable Papers contained in SCIENTIFIC AMERICAN SUPPLEMENT during the past ten years, sent *free of charge* to any address; also, a comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published, for free circulation, at the office of this paper. Subjects classified with names of authors. Persons desiring a copy have only to ask for it, and it will be mailed to them. Address

MUNN & CO., 361 Broadway, New York.

PATENTS!

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *forty-five years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases. Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.

BRANCH OFFICES.—No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.